AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION

VOLUME 24 — NEW YORK AND LONDON — NUMBER 11

Published at 218 William St., New York,
Every Thursday by the

American Machinist Press.

[INCORPORATED.]

Also published at 34 Norfolk St., Strand, London, W. C.,
Every Saturday.

Correspondence on mechanical subjects solicited. Name and address must always be given—not necessarily for publication.

Address all business communications to the American Machinist Press. Matter for reading columns may be addressed to the Editor.

Subscribers can have address changed at will. Give old and new addresses. Date on wrapper denotes end of month in which subscription expires.

Subscription Price:

$4 per year, postage prepaid, to any post office in the world. No back numbers beyond current year.
For sale by newsdealers, generally.

Subscription agent for Denmark, Norway and Sweden, V. Lowener, Copenhagen. Subscription agent for Germany, Austria and Holland, Gustav Diechmann & Sohn, Neue Promenade 4, Berlin. Subscription agent for Spain, J F. Villalta, Puertaferrisa, 7-9 Barcelona.

Entered at New York P. O. as mail matter of the second class.

Cable address, "MACHINIST," N. Y.
Lieber's and A B C Codes.

What Constitutes Manufacturing?

The exact dividing line between manufacturing and building machinery has never, we believe, been drawn, in fact most mechanics would probably say that there is no such line—that the one grows into the other by insensible degrees and that an exact line of demarkation cannot be found. Manufacturing is considered to lie in the volume of product of any one article and in the methods of its production, which become more refined and highly organized as the volume of product is increased.

There is, however, another point of view from which a sharp dividing line can be drawn and from which we believe the spirit of the two methods can best be defined. In a pure contract shop, in which no manufacturing is attempted, a distinguishing feature of the business is that there is an order on the books for every machine in progress in the shop. From the nature of the business the orders are taken before the work on them is begun. As the demand for an article or machine increases the proprietor of the shop begins to anticipate those orders and to make machines for sale from stock. At first he may make few or no changes in his methods. He gets an order for a machine of which he has already sold several and, recognizing that two or three can be made proportionately more cheaply than one, he starts work on them in expectation that the demand will continue and that he will be able to sell them. In doing this he has become a manufacturer whereas he was before a builder, the essential difference between his old and new practice being that formerly he did not begin work on his product until after the order was taken, whereas now he begins the work before taking the order, and this, it seems to us, constitutes the dividing line between building and manufacturing. As the business grows, this feature becomes more pronounced. Eventually he regulates the number of machines actually in progress at any one time by the general volume of business—he aims to have a stock of goods in the warehouse from which they can be shipped on receipt of orders and to have in stock a sufficient number to supply the demand until another lot can be completed. It is true that the demand may at times get ahead of his stock, but even in this case if the goods are really being manufactured the customer must wait until the lot in progress is completed, or, at any rate, substantially completed, before his order can be filled.

Locomotive building is an excellent illustration of the point we raise. Thirty years ago each locomotive works had designs of engines of various classes which were characteristic of the works from which they came. Railroads needing engines bought from the works whose designs most nearly met their needs or fancy or which could supply them on the best terms as regards price and delivery, precisely as the smaller machine tools or pumps are bought to-day. In locomotives, however, the character of the business has entirely changed—and for the worse, from the locomotive builders' standpoint. Contrary to the understanding of our English cousins, American locomotives are now, as a rule, built strictly to specifications in which the superintendent of motive power calls for whatever details he prefers. There may be two or more lots in progress at the same time intended for substantially the same service, but if they are for different roads they may differ widely. The essential feature of the business to-day is that the work is not begun until after the order has been secured. In other words, while locomotive building was formerly a manufacturing business, it is no longer so, the direction of progress in this industry being directly the opposite of that in most others. Meanwhile the volume of work turned out has enormously increased, the methods used are more advanced and the interchangeability of parts is much better than formerly, but this does not alter the fact that the course of events has been away from manufacturing in a fundamental sense.

In many cases certain parts may be manufactured while the machine as a whole is not—the distinction remaining as before, that these parts are made in advance of orders while the complete machine is not begun until after the order has come in. Locomotive works furnish also an illustration of this. In such works staybolts, for example, are made in immense numbers and carried in stock. This process may extend to much larger parts of which there are certain well-defined types, such as cross-heads, rod brasses, etc., but manufacturing those parts does not imply manufacturing the locomotive.

An apparent exception may be found in those cases of machine-tool manufacture, in which the product is not marketed by the maker directly but through one of the general machinery supply stores. Such a store may give an order to the maker for a certain number of machines, which will then be begun after the shop has received the order, although it is clear that the product is manufactured and not built. The exception is apparent only. A manufacturing enterprise consists of two ends—the manufacturing and the selling—and it is not complete without both. In this case, the two ends are in different hands and the selling end "carries" the stock of machines. They are still made for the warehouse, but the warehouse is maintained by the seller and not by the maker, and, so far as ultimate sale is concerned, they are begun in advance of orders. The order to the shop is essentially a "production order" only, for while the shop has the order the warehouse may have none. This case thus conforms to the rule laid down, as we believe all others will.

The Sampson-Morgan Incident.

In the Sampson-Morgan incident, which has been so much commented upon in the papers, the general public sees a manifestation of that spirit which undoubtedly pervades what is known as "the line" of the navy, and which spirit the engineers of the navy had to contend against in securing their rights, if indeed they have finally secured them, which seems very doubtful. The real fact is that many of "the line" officers of the navy seem to act

as though they imagined themselves to be made of a superior material and that it is presumption and impudence for anyone outside of the clique to aspire to put himself in a position where he may be associated with them. The endorsement made by Sampson on Morgan's application for advancement seems of course to be an extreme example of caddishness. It is, however, certainly no worse than numerous examples that occurred during the contest of the engineers of the navy for real rank and for some control over those things which they are supposed to be responsible for. It is to be hoped that some day the people of the country will generally understand something of the spirit that pervades the navy and will take such measures as will bring about what we consider to be a much-needed reform. According to Sampson's idea, Abraham Lincoln would have been particularly unfit to associate with naval officers, and had he applied for an examination for a position which would have brought him into such relations they would have resisted his appointment as being a person unfit to associate with gentlemen—that is, with themselves.

The New Process for Brazing Cast Iron.

In last week's paper we briefly described a newly invented process for brazing cast iron by applying to the surfaces to be united an oxide of copper to remove the graphitic carbon and protecting them against the influence of the air with borax or silicate of soda. If the reports of the extreme ease with which this process is applied and of its successful results are well founded, its discovery marks an important epoch in metal working. It was invented by an engineer named Poech and has been thoroughly tested at the Mechanical Technical Testing Institute at Charlottenberg, near Berlin. Prof. Martens, of this institute, testifies that the iron thus brazed stands the strain like new and has not deteriorated under the process. The discovery has already been applied by a number of prominent engineering firms in Great Britain.

This method of brazing is explained as follows: After the surfaces have been cleaned they are treated with a moistened mixture of "Ferrofix" (which is the term applied by the inventor to a metallic oxide, preferably of copper) and a flux such as borax, soluble glass, or better, "Borfix," a mixture recently patented by the same inventor. The surfaces are covered well with borax or Borfix, then with strong solder, such as is used for wrought iron, and then the metal is brought to a red heat. A chemical decomposition takes place in which the oxygen of the metallic oxide combines with the carbon of the iron to form volatile carbonic acid or carbonic oxide, setting free pure metal. This metal covers the surfaces of the iron intimately, filling the smallest pores and facilitates the direct and intimate union of the solder with the iron. The flux that has been added covers the place of the brazing with a vitreous skin, which prevents the oxidization of the iron and the soldering metal.

The avenues of utility suggested for the new process are three: First, repairing cast iron; second, putting together large castings, which may be made in sections to facilitate molding and transportation; third, brazing cast iron to other metals. In this way cast iron can be used in places where wrought iron or steel is now employed by making only that part out of the stronger metal which is exposed to especial strain.

While it is hardly to be expected that all pieces can be brazed with equal success, it is stated that a gear wheel 40 inches in diameter and weighing about 220 pounds has been satisfactorily repaired in six places in hub, spokes and crown. Moreover, bars 4 inches in diameter which have been thus brazed and then broken at the same place with a chisel showed a new line of rupture.

It is not known that "Ferrofix" has yet reached America, but it can be obtained in Germany from Rodolphe Winnike, of Berlin. It is also being introduced to the trade in England from H. Bertram & Co., 28 Queen street, London, E. C., who offer to supply full particulars.

Importance of Speed of Emery Wheels.

The superintendent of a well-known manufacturing establishment gives us some experience he has been having with emery wheels of late, which is interesting and instructive.

One of the foremen in the establishment referred to put in a requisition for some emery wheels that were to be duplicates of others that were already in use. The wheels were ordered, and when they came were put to work. The foreman reported that they would not do. They were "too hard," "burned the work" and otherwise acted badly. The maker of these wheels was written to, giving him a statement of the results and declaring that the wheels were not duplicates of those previously furnished. In reply the maker said that so far as he could determine the wheels should be, and he believed they were, exact duplicates of the ones formerly sent.

The superintendent then upon consulting with the foreman, and knowing that the wheels last ordered were used upon a new machine, found upon investigation that this new machine had been so belted up that the wheels were running much faster than the first wheels were; and when the speed was reduced to correspond with the other machines it was found that the new wheels behaved in exactly the same way as the older ones did, or, in other words, that they were entirely satisfactory and were evidently similar wheels.

Our superintendent concludes from this, what is undoubtedly the fact, that where an emery wheel is doing satisfactory work on a given job at a given speed, any change of the speed is likely to make that wheel work unsatisfactorily on the same job and to make it appear as though the wheel itself were of an entirely different nature. It is also found to be a good practice to experiment somewhat with the speed of a wheel when for any reason it is found not to work satisfactorily. Sometimes a wheel works very badly, but when the speed is either reduced or increased, works in an entirely satisfactory manner. The incident also shows, as our superintendent remarks, how easy it is to be mistaken and how easy it is to charge a failure to the wrong cause, this of course applying, not only to failures of emery-wheels, but to many other things used in machine shops as well—a fact that most tool builders know full well.

Legal Notes.

BY W. M. SEABURY, LL. B.

EXPLOSION OF BARREL USED TO HOLD CASTINGS.

Samuel Purdy, while employed by the Westinghouse Electric & Manufacturing Company as a common laborer, received injuries for which he sought to recover damages. He was engaged with other workmen in receiving castings brought in barrels from Newark to East Pittsburgh, Pa. The barrels had been obtained by the purchasing agent of the company from "a dealer in second-hand barrels. They had originally contained oil, alcohol, turpentine, benzine, whisky and other things." The object of the agent was to procure any kind of strong barrel that would hold from 500 to 700 pounds of castings. These barrels were in a dark place, and while Purdy was inspecting one of them to ascertain the number upon it, another workman lit a match and an explosion followed. Purdy brought suit in the Court of Common Pleas, Allegheny County, which rejected his claim on the ground that there was insufficient evidence to establish it. On appeal, the Supreme Court, which is the court of last resort in Pennsylvania, affirmed the judgment and said: "There is no testimony in the case which shows that the defendant company or any person connected with it knew that the barrels used as above stated were under any circumstances explosive, nor is there any testimony showing that such barrels are not commonly and ordinarily used for such purposes at manufactories, or that they are in any way unsuitable for such use." The court then applied the familiar doctrine that an employer is not obliged to supply the best materials known nor to subject such as he does supply to an analysis to determine what hazard may be incurred in their use. (47 Att. R. 237.)

Commercial Review.

NEW YORK, Monday, March 11.

MACHINE TOOLS AND OTHER MACHINERY.

Favorable reports from representative tool manufacturers and dealers continue to be the rule. March ought to be an active month, and it has opened auspiciously.

We have received two circulars containing the official announcements of the purchase of the Arcade File Works, Anderson, Ind., by the Nicholson File Company, Providence, R. I. One is signed by the Allerton-Clarke Company, 97 Chambers street, New York, anouncing the termination of their connection with the Arcade File Works as selling agents and extending their good will to the new owners. In the other circular the Nicholson File Company states that it has purchased the Arcade File Works and will continue the manufacture of this brand of file and that all orders, inquiries for prices and correspondence in connection with the business of the Arcade File Works should be addressed to the Nicholson File Company at Providence, R. I.

The New York office of the Cleveland Twist Drill Company will be moved May 1 to 62 Reade street, where a larger store will be fitted up. The company carries a stock here to supply the North Atlantic seaboard above Norfolk. The increases in its business here in the last few years have been very great.

The Toledo (Ohio) Machine and Tool Company informs us that since the agitation concerning the formation of a tin-can trust many large users of cans have placed their orders for equipments to supply their own cans. A large plant is now being shipped to a concern in Western Illinois, and a number of other tin-can equipments are nearing completion.

The General Electric Company has again outgrown its quarters at Schenectady, N. Y., and has let contracts for a 200-foot extension to shop 16, the big machine shop. It will also put up a large new office building and will add another story to shop 26.

Near the new works to be built by the E. P. Allis Company in a suburb of Milwaukee, Wis., is to be located quite a colony of other machinery manufacturing concerns which are to move out from the city. Deals with the Central Land Company for sites are said to have been closed already by the Prescott Steam Pump Company, now located on Oregon street, of which F. M. Prescott is the president; the Rosenthal Corn Husking Machine Company, now located on Thirty-first and Walnut streets, and the Milwaukee Electric Company, whose business is now conducted on Reed street. The Prescott concern has purchased two acres in the new manufacturing section; the Rosenthal company has purchased four acres, and the electric people will have three or four acres. These concerns will at an early date erect permanent plants. The Rosenthal company expects to employ 200 men. There is one other manufacturing concern which is said to be negotiating for several acres.

The New York, New Haven & Hartford Railroad has decided to transfer to Newport, R. I., all its repair shops for its various boat lines—the New Haven, Norwich, Stonington, Providence and Fall River. Four docks will be available for the purpose, two of them over 500 feet long. The repair shops will cost about $250,000 and will consist of the following 2½-story buildings: A carpenter shop 55x100 feet; a machine shop 55x100 feet; a power house 75x100 feet; a storehouse 40x80 feet; a blacksmith shop 45x75 feet; a boiler house 45x125 feet; an office building 25x125 feet, besides several smaller buildings. The machine shop will be fitted up with all the modern appliances, etc. In the center will be a space of 22 feet square in which to operate a crane, and there will be a gallery on two sides of the building.

As a result of the circular letter sent out by the export house of Markt & Co., Ltd., calling attention to the danger to American trade from the Russian tariff imbroglio, the firm has received many letters promising support and offering to exert influence upon Senators and Congressional representatives for a repeal of the countervailing duty. Among those who endorsed the views put forth are the Nicholson File Company and the Builders' Iron Foundry, of Providence.

How important are the fears rapidly growing in English iron and steel circles that the industrial position of the country is about to suffer serious change is shown in these press dispatches from London:

"England's industrial panic at sight of the great invasion of American competitors continues to grow and now claims the attention of all classes. It has required the great American steel combine to bring a dim realization to some of the labor leaders that their policy, perhaps, has had something to do with the impending disaster to British industries. Keir Hardie, M. P. for Merthyr-Tydvil, and editor of the 'Labor Leader,' makes the vital admission that, although wages in America are double those of the English workingman, yet the cost of labor in making steel in the United States is only one-half the cost in England. It signifies that trades unionists are beginning to understand at last that British workmen must do more for their wages or go to the wall. The closing of iron and steel works, which has already begun, will become general within a few months, and trade once lost will not be regained when America's great natural advantages are also in the opposite scale. The press is filled with comment and advice."

"The Right Hon. Henry Asquith, M. P. for East Fife, speaking at Coventry on the defects of the British industrial system, said: 'We are seriously threatened in our industrial system for the first time in our history. The exports of the United States now exceed those of Great Britain. The truth is that we have lost our start in the race, and that other nations, both in opening out their material advantages and still more in training the industrial intelligence of their citizens, are everywhere and in all markets pressing us hard.'"

Statistics of the imports of the German Empire in 1900 just at hand show 4,757 tons of machine tools imported from the United States. The largest quantity imported from any other country was 588 tons, from Great Britain, while 388 tons came from France, 259 from Austria-Hungary and 184 from Belgium. Other kinds of machinery imported from the United States included 20,249 tons of agricultural, 343 tons of electrical, 200 tons of steam engines, 331 tons of pumps, 102 tons of punches and shears and 574 tons of elevating machinery.

What a German contemporary of ours calls "a sign of the times" is the announcement by a machinery-building establishment in Frankfurt a. M., heretofore called the Deutsche-Amerikanische Maschinengesellschaft (German-American Machinery Company) that it has decided to un-Americanize its appellation and has become incorporated as the Maschinenfabrik Moenus Aktiengesellschaft. The concern is a purely German one in capital and conduct; it formerly had some relations with America, but now, with its own inventions, patents, licenses, shop and foundry, it stands on its own bottom and wants all the world to know it. At the Paris Exposition it was awarded Grand Prizes for shoe and tannery machinery, two lines in which it admits the United States once excelled. The company has a capital of only 5,000 marks, but it may serve as a straw to show the way the wind blows. Here is what it has to say:

"For years North America has tried to capture foreign markets, everywhere. It has become the duty of other countries to refuse further aid in doing so, but rather, standing together, to show the world the capabilities of Europe. A forceful rejection of American products seems the more fitting treatment of that country because through extravagantly high protective and exclusive tariffs—true prohibitive tariffs—its own markets are well-nigh closed."

O. S. Spaulding, Assistant Secretary of the Treasury, has notified the Collector of Customs for the port of New York, that the firm of W. P. Cook & Co., of that city, are entitled to a drawback allowance on the exportation of galvanized-iron pipe manufactured by them and in the manufacture of which no other than the iron pipe imported in a plain or ungalvanized state has been used, such drawback to be less the usual legal deduction of 1 per cent.

CHICAGO MACHINERY MARKET.

While trade in engines and boilers is fully as good as a year ago, the market has the appearance of being a waiting one. This is because inquiries are so much greater now than then. A relatively less percentage of these inquiries is being closed. One large manufacturer remarks that inquiries are three times the number of a year ago, which, if reconciled with the first statement made above, would mean that only one-third as many of the inquirers are now closing for their needed power. It is not easy to account for this relative backwardness. Perhaps it is due to say that the most active season of the spring trade has not yet arrived and that quite a different showing may be presented in April. Certainly if present promises are realized the business for this year in power will far eclipse the trade of 1900, which was unusually large.

The inquiries come from all directions and from all possible classes of buyers. Perhaps the call for the smaller engines, running from, say 100 to 300 horse-power, is relatively more active than for the larger units. Much of the work in sight consists of the displacement of old by new power. Prospective buying manufacturers may be a little slow, but they are figuring on many improvements. The future of their trade could not well be brighter, generally speaking. There are not facing trade this year, as there were in 1900, financial uncertainties, with a Presidential election ahead to unsettle industrial growth. The prospects are without a cloud and order books are in some instances so well filled that the year's work is almost a matter of certainty. Hence the numerous inquiries.

Among orders recently taken by the E. P. Allis Company are the following: A 1,500 horse-power cross-compound Corliss engine for the Des Moines (Iowa) street railway company; a combined vertical and horizontal engine, cylinders 40 and 80 by 60, for a rolling mill of the American Steel and Wire Company, Cleveland, Ohio, difficult to rate in power perhaps, but supposed to be equal to running up to 8,000 or 10,000 horse-power, though normally much lower; an 800 horse-power engine for the F. S. Tyler Company, Cleveland, Ohio. Many smaller engines were sold by this company during the past few weeks. They have also just sold ten large blowing engines to the Carnegie Steel Company.

The Northwestern Railway is in the market for some engines for the Chicago station, and has just bought some tubular boilers of about 1,000 horse-power to take the place of the boilers there which exploded some weeks ago.

Notwithstanding the decision of the Supreme Court of Michigan declaring the sugar-bounty statute unconstitutional, the sugar-beet industry in that State seems to be reviving. Wickes Brothers have sold boilers of 2,000 horse-power each for beet-sugar plants to be erected at Saginaw and at Lansing, in that State.

CINCINNATI REPORT.

Conditions with representative concerns in this market continue to show an upward tendency, with little disposition on the part of any manufacturers affected by the Russian countervailing duty imposition to be perceptibly worried, save perhaps makers of wood-working lines. The Fay-Egan Company has several thousand dollars' worth of machinery in transit which will be affected, and its president, Mr. Thos. P. Egan, is active in co-operation with the National Association of Manufacturers to effect a modification or revocation of the order. The committee expects some kind of definite action at the dinner of the Manufacturers' Club, Monday night, when the committee will report Secretary Gage's ultimatum and the official letter of President Search, and probably urge immediate action through the Board of General Appraisers and the United States Courts. Personally it can be reported as the sentiment of the officers of some of the largest machine-tool works here that Secretary Gage has not acted in sincerity. It is not the present that offers any special disappointments to these men—it is the future, for there are comparatively few machine tools from this section in transit between America and Russia direct. The largest Cincinnati concerns are selling Russia just now through Germany. There is little or no new foreign business reported. Domestic, on the contrary, is showing a most agreeable improvement, particularly in orders for electrical machinery, in medium and small size units.

The Lodge & Shipley Machine Tool Company is experiencing about the normal run of domestic business at this time. It is getting out a large lathe, a 60-inch machine, which will give the company's line fourteen distinct sizes.

The Cincinnati Milling Machine Company notes a good demand for machines of the larger sizes. This concern installed in its works as an experiment some years ago, when the idea was new, an air compressor. Since that time it has put in about three times the power, and it is understood a number of the other concerns have followed its example, so that compressed-air plants are comparatively common. The R. K. Le Blond Machine Tool Company is putting in a complete plant of this character for operating hoists and miscellaneous similar machinery.

In a general way it may be said that manufacturers of tools and allied lines are not fearful of any unpleasant results from the new steel trust. They look at the matter philosophically, believing that there is yet plenty of competition on the outside of the trust, and that while prices of material may advance sharply within the next few months they will gradually resume their normal level in the summer. Jobbers have commenced to buy, and while not stocking up much, seem to incline more favorably to special types for special orders. There has been no recent word from the British Westinghouse contract, and it is expected to be fully thirty days yet ere the bidders will have any definite information.

The boiler men, while noting an advance in boiler and sheet plate, have made no material advances in the finished product. The Tudor company has commenced the installation of its important additions. Among recent orders is one for three water-tube boilers, each 200 horse-power capacity, for the Bullock-Pollak Iron Company, Cincinnati, which concern is putting up some additions to its factory. It turns out car-wheel axles and heavy forgings.

The Gaylord Pipe Foundry, a landmark for half a century of Newport, just opposite Cincinnati, is being demolished. The foundry was in its day considered the most complete in the United States for the milling and handling of 76-inch pipe. A wrecking firm is dismantling and removing the entire plant to Addyston, where it is to be reconstructed within ninety days.

Certain Cincinnati manufacturers have been importuned to learn of the scheme of one Capt. William Crawford, of Columbus, Ohio, who has invented a new motive device which he claims will completely revolutionize the operation of traction vehicles and all sorts of machinery.

Quotations.

NEW YORK, Monday, March 11.

Iron—Pennsylvania Pig, Jersey City delivery:

No. 1 X foundry	$16 00 @ $17 00
No. 2 X foundry	15 50 @ 16 00
No. 2 plain	15 00 @ 15 50
Gray forge	14 00 @ 14 50

Alabama Pig, New York delivery:

No. 1 foundry, or soft	15 50 @ 16 00
No. 2 foundry, or soft	15 00 @ 15 50
No. 3 foundry	14 50 @ 15 00
Foundry Forge, or No. 4	13 75 @ 14 25

Bar Iron—Base sizes—Refined brands, mill prices on dock, 1.50 @ 1.60c.; from store, 1.75 @ 1.90c.

Tool Steel—Base sizes—Good standard quality, 7c.; extra grades, 10c. upward.

Machinery Steel—Base sizes—From store, 1.70 @ 2.50c.

Cold Rolled Steel Shafting—Base sizes—From store, 2½ @ 3c.

Copper—Lake Superior ingot, 17c.; electrolytic, 16⅝c.; casting, 16½ @ 16⅝c.

Pig Tin—26 @ 26¼c., for 5 and 10-ton lots, f. o. b.

Lead—For wholesale lots, 4⅜c., with .02½ extra for carloads.

Spelter—3.92½ @ 3.95c., New York.

Antimony—For 5-cask quantities, Cookson's is about 10½c.; Hallett's, 9c.; Japanese, 8.70 @ 8.75c.

Lard Oil—Prime City, in barrel lots, about 65 @ 67c.

The Manufacture of Rapid Fire Guns—I.

BY E. G. PARKHURST.

FOUNDATION OF THE GUN BUSINESS.

The foundation of the whole gun business is the material from which the gun is made. Science has determined steel to be the best suited for such purpose, and has also developed testing machines whereby its quality may be for a certainty known. It is now no longer necessary to test guns by excessive charges of powder, which often injured the metal. The danger which always exists, when explosives are used, is now reduced to a minimum by determining beforehand all the physical qualities of the steel.

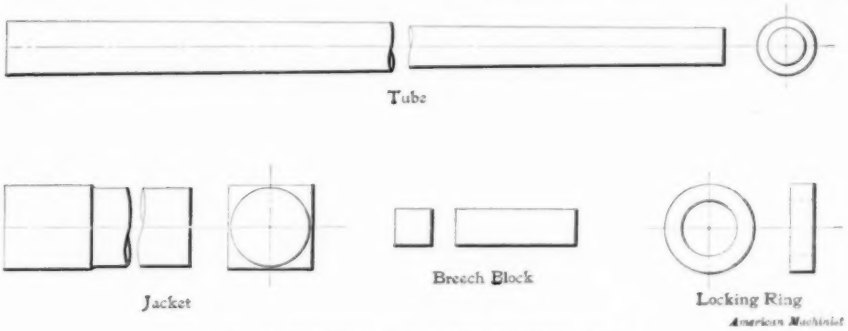


FIG. 1. FORGINGS FOR A SIX-POUNDER GUN.

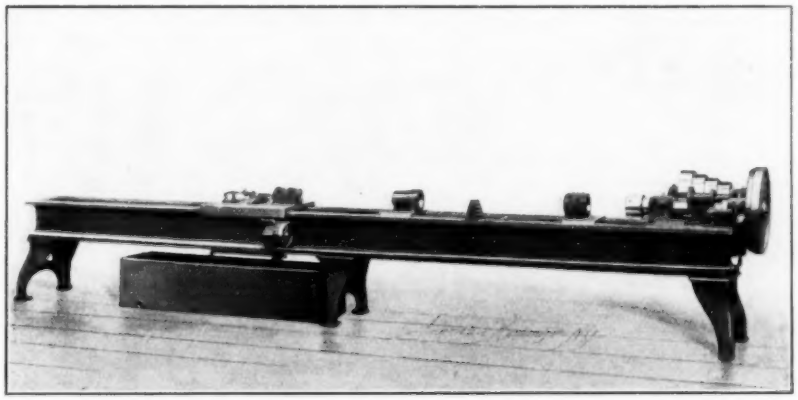


FIG. 2. TUBE BORING MACHINE.

MATERIAL FOR RAPID-FIRE GUNS.

The main forgings for a 6-pounder gun are shown in Fig. 1. The material is open-hearth steel, each principal part being cast in a separate ingot with an excess of weight of not less than 33 per cent. above that of the rough unbored forging with the test specimens on. From each ingot 28 per cent. is cut from the upper end and 5 per cent. from the lower end to avoid unsoundness that would injuriously affect the finished gun. The lower end of each ingot as cast must be the breech end of the forging made from it, and each forging is left long enough to have the test specimens cut from it. All forgings are rough bored, and turned to a size which allows ample finish. They are then annealed, oil tempered and again annealed. All heating for tempering and immersing is done with the forging in the upright position, the whole piece being subjected to the treatment at the same time.

PHYSICAL TESTS.

Physical tests are directed toward the exhibition of all the principal physical qualities of the metal. Those to which particular attention must be paid are tensile strength, elasticity, extensibility and contraction of area.

There is cut from each end of every forging, for tubes, jackets and breech blocks, after tempering and annealing, one specimen of ½ inch diameter and 2 inches between measuring points. The specimens are so cut their axial lines lie as nearly as possible in the middle thickness of the finished section of the part to be tested. They are cut transversely wherever the size of the rough-bored and turned forging permits, otherwise they are longitudinal.

The test specimens must show in each the physical qualities shown in the table:

REQUIRED PHYSICAL QUALITIES OF GUN MATERIAL.

	Transverse specimen	Longitudinal specimen
Tensile strength, lbs per square inch	87,000	87,000
Elastic limit, lbs. per square inch	45,000	45,000
Elongation, per cent	17	20

LEADING OPERATIONS AND TOOLS USED IN MAKING THE GUN—THE BARREL.

The forgings having passed inspection, the rough machining is done by ordinary methods with the exception of drilling the tube, which is done on a special machine using a forced oil circulation through a hollow bit, similar to the machine shown in an article by the writer on the "Manufacture of Military Rifle Barrels," published in the "American Machinist" No. 17 of last year.

The machine used for drilling and boring heavy gun tubes is shown in Fig. 2. It is provided with pump, oil tank and all other needed attachments.

The drilling bit is shown in Fig. 3 and is also similar to the one used in boring the barrels of small arms. The tool for large work has a spiral chip groove and an oil channel which is first milled spirally and is then covered with a strip of thin metal soldered in a beveled undercut. The cutting lip is stepped to break up the chip. The tool is ground in a fixture mounted on the bed of the grinding machine, which gives the required angle at the cutting lip.

After a tube has been oil-tempered and annealed, the bore is tested to see if its lack of truth is too great to be corrected by the roughing reamer. The tube is swung in a lathe center rest and an indicator is inserted, having a swinging

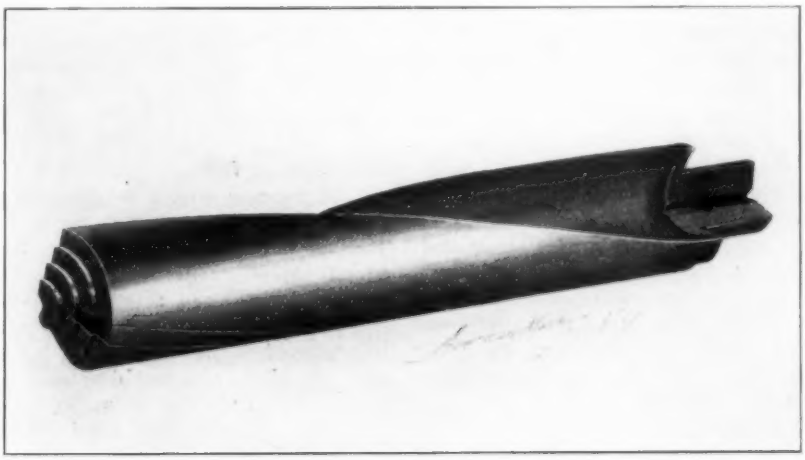


FIG. 3. DRILL BIT FOR THROUGH BORE.

bar, with a ball on the end entering the bore. This ball, by spring pressure, is made to bear on the surface of the bore and as the tube is revolved the movement of the outer end of bar shows the error in the bore.

If the error is found to be too great for the roughing reamer to correct, the tube is taken to the hydraulic straightening machine shown in Fig. 4. A cradle carried by

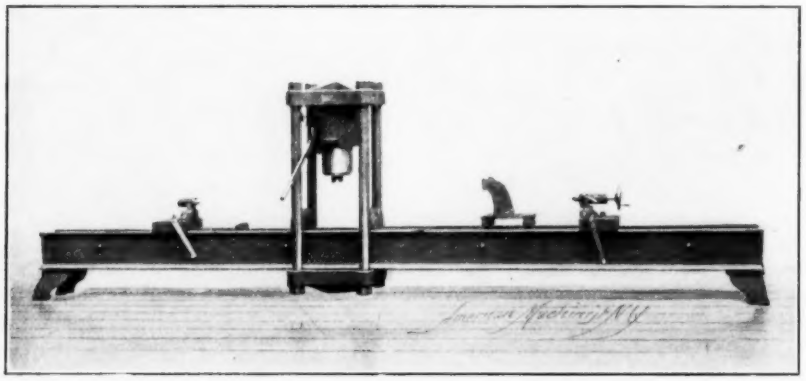


FIG. 4. HYDRAULIC STRAIGHTENING PRESS.

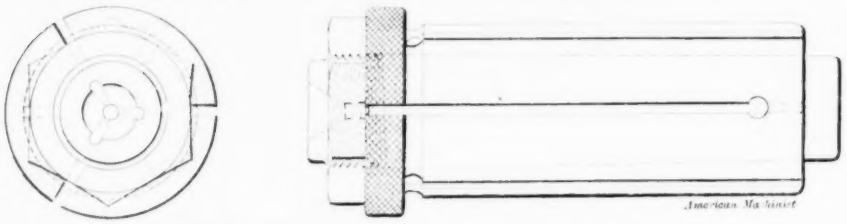


FIG. 5. MANDREL AND EXPANDING BUSH ON WHICH TUBES ARE TURNED.

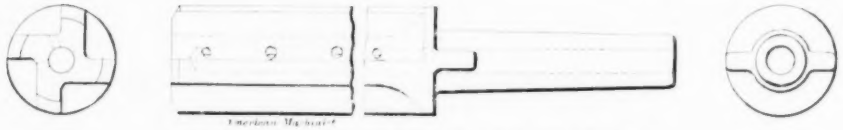


FIG. 6. ROUGHING REAMER FOR SIX-POUNDER TUBE.

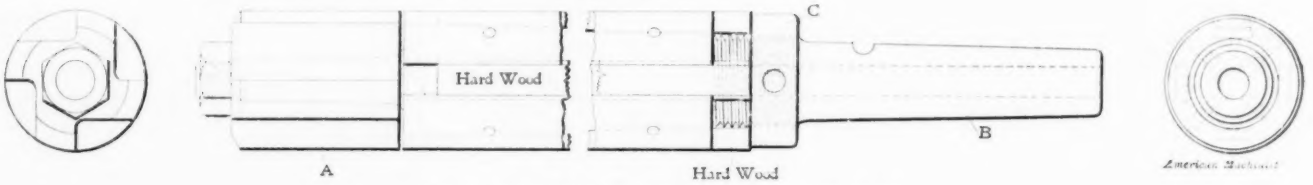


FIG. 7. FINISHING REAMER FOR SIX-POUNDER TUBE.

with a clearance in a special fixture. The outside is ground taper—about .0005 inch in its whole length. It is hollow and oil is forced through the shank. The chips are driven out of the front end by the oil. The success of the operation depends on the quality of steel used in the reamer. Under no circumstances should the cutting edges be oil-stoned. The bit should be left as it comes from the grinding fixture.

The cutter must fill the guide bush, which must be exactly concentric with the revolving tube. When the cutter has been fed into the tube slightly beyond its length, the circular spanner nut at the rear end of the wood pieces is screwed up. When the body of the tool is in nearly its depth the operation is repeated. As in the case of the roughing reamer, the oil stone should not be used on the cutting edges. Danemora steel has been used for these tools with excellent success. On the hardness and staying quality of the steel the perfect bore of the tube depends.

Following the finish reaming the tube is straightened, if need be, under hydraulic press (see Fig. 4), errors in the bore being detected by the method of "shade lines" which was fully explained in the article on "Military Rifle Barrels," published in issue No. 17 of last year. Following this the tube is rough-turned all over and finish-turned in its taper part. A groove is also turned near the muzzle for supporting the tube when shrinking it in the jacket. The jacket-shrink fit is turned and gaged and two notches are milled for a hold-fast when rifling the bore.

MACHINING THE JACKET.

The jacket forging is first swung in the lathe, the piece being caught at the breech end in a cup chuck with four set-screws. The muzzle is supported on the center by an expanding mandrel and two spots are turned for the boring fixture, which is mounted on the carriage of a horizontal boring lathe. A small bar with double cutter is first used for putting through the loading hole followed by a large bar for the barrel fit.

The fixture used is down in Fig. 8. It is an old-time apparatus, though exceedingly efficient for the purpose. The accuracy of the bore is dependent on the fit of the bushes and a parallel boring bar, which is made with care, the surface being lapped as nearly perfect as may be. The cutters have double cutting lips locked over the bar and have three bearing points on edges, two on the bar and one on the key, as shown. The cutters are ground in their own positions when keyed fast in the bar. The bar running in the bushes it is not controlled by the lathe centers. During the boring the ends of jacket are closed enough to hold the oil. The cutter is thus well lubricated—in fact, runs in oil.

Here we would remark that excellent work has been done on tubes by a boring bar and two double-end cutters

four rolls, which travel on the inside lower flange of the I-beams forming the bed, has four upright rods. These rods carry an inverted 110-ton hydraulic jack. The rolls secure easy traverse of the jack to any desired point over the piece to be operated on. V-supports are provided for the tube and also adjustable centers on which the tube can be revolved if desired. Following the straightening process the tube is swung on a pair of expanding mandrels shown at Fig. 5 and spots are turned at each end for the lathe chuck and center rest. The tube is then again taken to the boring machine, Fig. 2, and rough reamed with the tool shown in Fig. 6. This bit is about eight diameters long over all and has four cutting lips which are ground

The finishing reamer which is also used in the same machine is shown in Fig. 7. The cutting head is about 2¾ inches long and about .006 inch less in diameter than the finished bore. It is ground the least shade tapering from the cutting lips which are the same as on the roughing reamer and are ground on the same fixture. Through the head is a tapering hole and a keyway to secure it to the body of the tool, which is about seven diameters in length, exclusive of the shank by which it is secured to this hollow drill bar. In the body of the tool four dovetailed slots are cut which are tapered at the bottom. Into them pieces of hard wood are fitted which should be thoroughly soaked for several weeks in oil before being used.

set at right angles. After the second cutter has passed into the bore, four set-screws so set that their bearing ends would be between those of the cutter are carefully adjusted to the bore, thus forming eight lines or points of contact. The tube slowly revolves in an opposite direction from the cutter.

Following the boring the hole is star-gaged at each inch of depth. The star gage is shown in Fig. 9. It takes its name from its peculiar form, having four contact points radiating from its head which is secured to a hollow tube called a staff, which when desired for the measurements of long bores can be secured (by screw-threads) to other bars, of which the one here represented has three. Through the bar connected to the head is passed a rod which terminates at the head end, in a double incline or wedge of suitable pitch and length, and has its undersides cut in the form of a T to engage with T-slots cut in two cylindrical right-angle slides, which in turn are screwed into the measuring points. Thus by pushing the wedge through the right-angle slides in the head, the measuring points may be positively driven out or withdrawn. The rod connected to the wedge extends to the outport end and is connected to a slide on the outside of the staff, having a vernier scale which records the sliding movement. Thumb-pieces on the slide project above the body and are used to control it in either direction. The rod is constructed in lengths that may be screwed together to suit the different bars. There are two sockets in the head at right angles to the measuring points, which are provided with legs resting on spiral springs for the purpose of centering and supporting the gage when in a bore. The outside of staff is graduated its entire length to read in inches, beginning at the measuring points, in order that the exact distance of the gage in the tube may be determined in inches and parts, and the size of bore be recorded on the vernier scale.

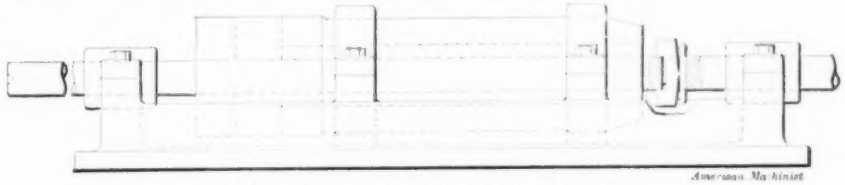


FIG. 8. FIXTURE AND BAR FOR BORING JACKET.

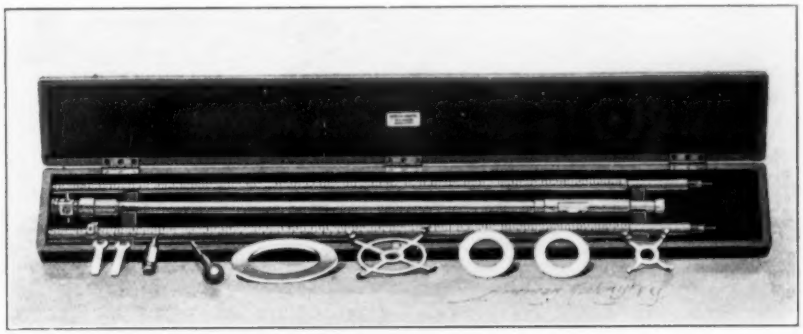


FIG. 9. STAR GAGE WITH THREE BARS, 31.50, 75.50 AND 110 INCHES LONG. VERNIER READS TO 1-2500 INCH.

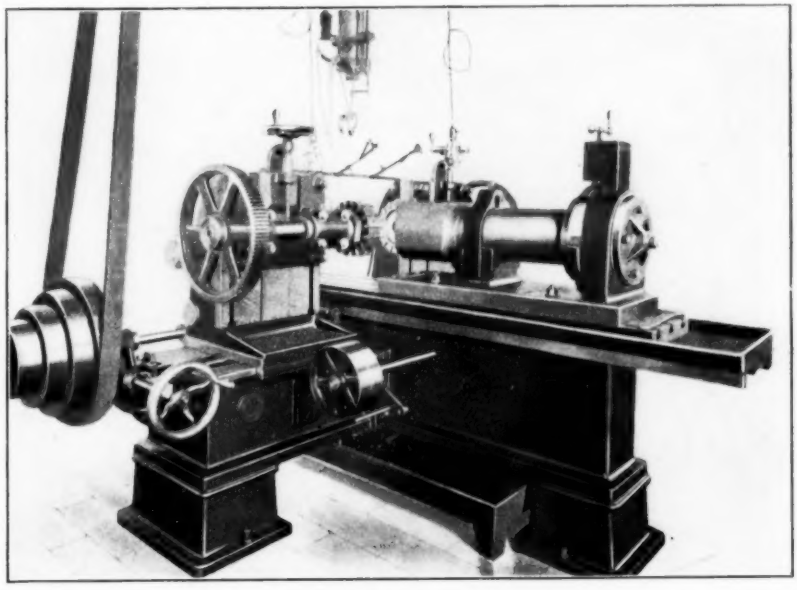


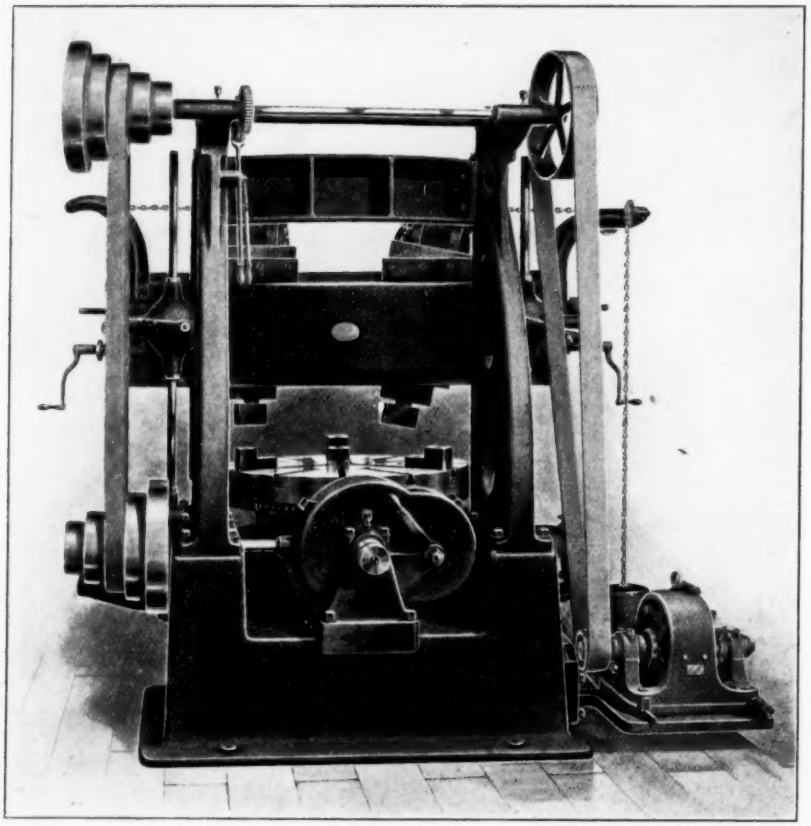
FIG. 10. MACHINE AND FIXTURE FOR MILLING SQUARE AND BREECH OF JACKET.

In all cases there should be a master ring gage of known dimensions, for establishing normal size. In operation the ring gage is placed over the supporting points of the star gage, and the wedge rod slide is adjusted with a forked screw-driver, until zero marks on staff and scale coincide. The measuring points are then drawn and the ring slipped off. The gage being then inserted in the bore and the measuring points pushed out to contact, thus the size of the bore above or below the ring gage may be read. The instrument requires delicate usage, and when properly adjusted and carefully handled it gives satisfactory results.

The piece is then turned straight back to the square of the breech with a short taper at the front end the breech is faced, and the circle cut at the breech is made. Following this it is square-milled at the breech end by the machine and fixture shown in Fig. 10. Following this, in order, the following operations are performed: Cutting thread of screw for the mount slide in a screw lathe; rough boring the breech housing in a boring lathe; machining the breech housing in a slotting machine; cupping the loading hole at the rear in a boring lathe; planing the straight way above the loading hole; drilling and reaming for the crank the stop pin and the rear sight in a horizontal boring lathe; planing for the extractor recess on a planer and for the rear sight finders and mount key on a shaper; shaping the circle cuts above the loading hole right and left on a slotting machine, and rough and finish milling for the extractor on a special milling machine.

The extractor cut (a T-slot) is quite a difficult operation to execute, inasmuch as the apparatus in which the arm of fixture has to be driven with its milling tool is about 8 inches from the rear of jacket. Therefore the cut would be termed interior milling, and the method of conveying power to the cutter was "quite a nut to crack."

The "Jeweler's Circular" prints the following recipe for "softening" steel: "For the purpose of softening steel it is heated to a brown-red and plunged into soft water, river water being the best. Care should be taken, however, not to heat over brown-red, otherwise it will be hard when immersed. The steel will be soft enough to be cut with ease, if it is plunged in as soon as it turns red." This would not work satisfactorily in a machine shop, at least with old-fashioned machinists.



37-INCH BORING AND TURNING MILL, MOTOR DRIVEN.

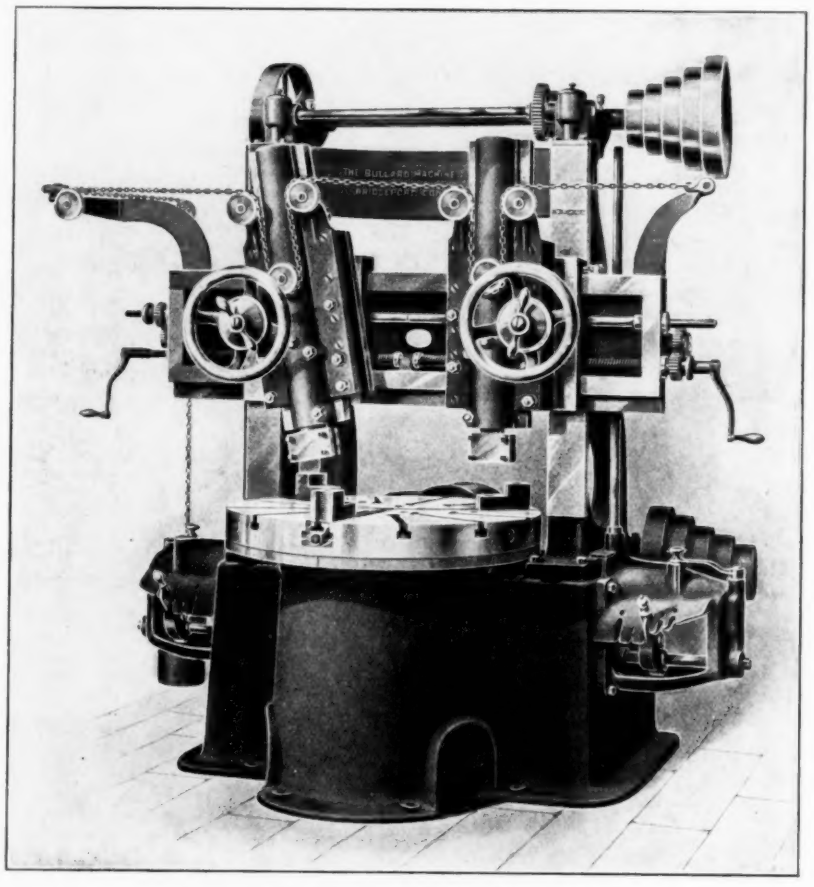
A Newly Designed Motor Driven Boring and Turning Mill.

We present herewith two views of a recently designed boring and turning mill, which is different from its predecessors in several particulars, the most prominent of these being in the provision made for driving the mill either by a belt or by an electric motor, as may be most convenient to the purchaser, either when he first sets it up or at any time afterward.

The front view of the mill shows it as it would be arranged for driving by a belt, the belt from the countershaft coming down to the plain pulley at the left above the housings, and the cone pulley being shown at the right. When it is to be driven by a motor the arrangement is as shown in the rear view of the mill, where the motor is seated upon an angle plate or bracket with provision for moving it one way or the other to adjust the tension of the belt. This arrangement has made it necessary to design a new system of gearing for driving the table and in doing this advantage has been taken of the opportunity to concentrate the gearing, to enclose it in a dust and dirt-proof case and so arranged that the gears run in a bath of oil. The rear view of the machine shows the arrangement; the lower cone shaft carries at its inner end a small bevel pinion which drives into a large bevel gear within the case and from this gear motion is transmitted through the back gears to the main driving shaft which has upon it the pinion which engages with the bevel gear teeth cut upon the underside of the table. A very great reduction of speed occurs within this case so that the cone belt runs at a relatively high speed and may therefore be narrower and more easily handled than would otherwise be possible, the convenient location of the upper cone pulley making it also unnecessary to use a pole in changing the belt.

The form of cross-rail has also been improved by making square locking surfaces throughout the saddles and providing an extra broad-bearing surface at the bottom.

The table of the machine is 37½ inches diameter, and into it is built a compact, powerful and dirt-proof combination chuck, the jaws of which can be readily reversed or removed. Ten changes of speed are provided and there are also ten changes of feed to range from 1-32 to ¾ inch horizontally, and from 1-50 to ½ inch in angular or vertical directions. The cross-rail is raised and lowered by power, the feeds are positive and the rate of feed is changed by the movement of the levers seen at the feed boxes on the right and left hand sides of the machine—there being two of these in this case because the mill has two saddles on the cross-rail which are fed and can be moved entirely independently of each other. Either head can be carried to the center for boring. The capacity of the



37-INCH BULLARD TURNING AND BORING MILL.

mill is for work 40 inches diameter, 32 inches high. It weighs about 9,800 pounds, and is made by the Bullard Machine Tool Company, Bridgeport, Conn.

A Large Worm-Wheel Hobbing Machine.

The growing use of worm gearing (which has been stimulated by our article showing the attributes of such gearing that are necessary to its successful working) has caused a demand for efficient worm-wheel hobbing machines of larger sizes than have been previously used, and we illustrate one of these made by the Grant Tool Company, of Franklin, Pa.

A LARGE WORM-WHEEL HOBBING MACHINE.

It is designed for automatically cutting worm-wheels from 6 to 48 inches in diameter, and of any pitch. Wheels can be cut either from the solid or dressed out with the hob from cast teeth. In no case is it necessary to nick them.

The machine is very rigid, and has ample driving power to drive an 8-inch diameter hob of 4-inch pitch. The head is back-geared in ratio of 8 to 1. The cone pulley has four steps 5 to 14 inches for 3-inch belt. The spindle of hammered steel is 3½ inches diameter, the front bearing 11 inches long. The cutter arbor is held in position by a key passing through the spindle and arbor at the front end. All driving gears are housed. Wheels either right or left hand can be cut with equal facility. The wheel to be cut is placed on an arbor in the spindle and adjusted to the required hight by a hand-wheel. For this a device resembling a micrometer is swung over the rim of the wheel and when set to read the width of the rim forms a gage to bring the wheel to such a hight that the center of the rim is in line with the center of the hob arbor.

The sleeve carrying the work spindle is rotated by a worm-wheel and a worm on a shaft that is driven through bevel and change gears for right or left worms. The worm-wheel has a cam on the side of the rim which moves a rocker on the shaft, giving motion to an arm which is connected to the feed-screw by a friction ratchet with a double pawl, giving a feed from .0 to 1-32 inch per revolution of the hob. A stop not shown, having a micrometer reading can be set for the distance between centers of worm and worm-wheel, and will stop the feed when the right depth of tooth is cut. The foot-block has an adjustable bronze bush which is a bearing for the outer end of the hob arbor.

There is a pan under the machine to catch oil, and a pump can be attached.

The maximum distance between the center of the hob spindle and the center of the work, allowing for 44-inch wheel and 8-inch hob or 48-inch wheel and 4-inch hob spindle is 26 inches; minimum distance, 3 inches; hight from top of work spindle at the lowest position to the center of the hob spindle, 10 inches; vertical adjustment, 2½ inches; feed from .006 to .036 per revolution of wheel; weight, 3,500 pounds.

High Speed Toothed Gearing.*

BY JAMES CHRISTIE.

For the transmission of power it frequently becomes necessary to use toothed gearing, subjected to high peripheral speed conjointly with high pressure per unit of tooth contact, and the object of these remarks is to record what has been successfully done in recent years, as much higher speeds are now successfully attained than formerly. Considered in a static sense, the gear tooth satisfies the condition of stress if it is proportioned to endure forces acting transversely on it, and the pressure per unit of contact is not of such intensity as permanently to deform the curved bearing surface of the teeth. When in motion, the curved surfaces slide upon each other as they enter and leave contact, and when this sliding action is accompanied with high pressure, the limit of endurance is soon reached, and in the case of the inferior materials this occurs at comparatively low speeds and pressures. In addi-

*A paper read before the Engineers' Club of Philadelphia

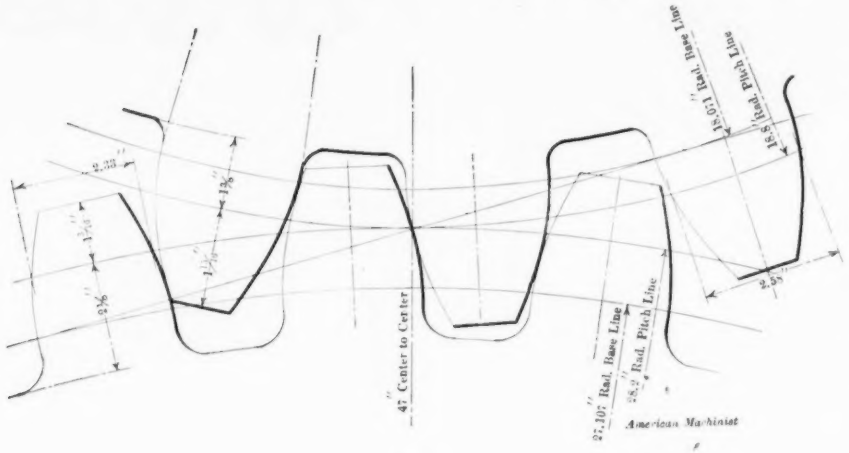


FIG. 1.

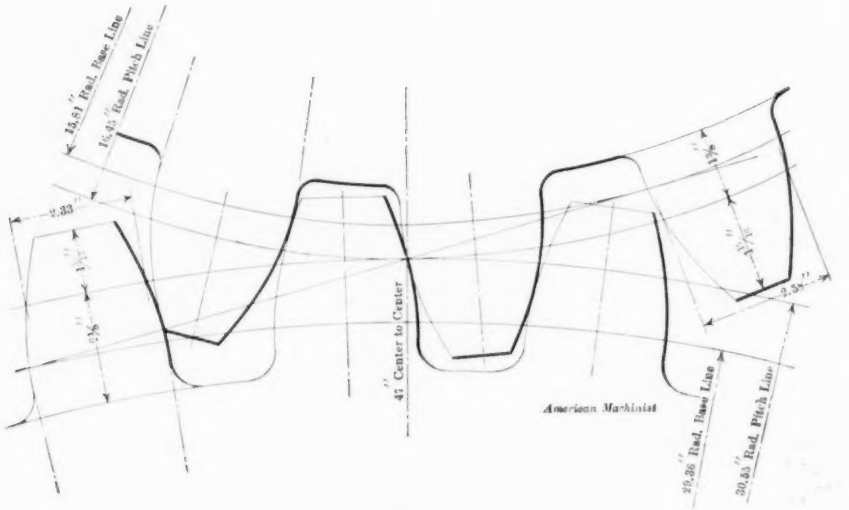


FIG. 2.

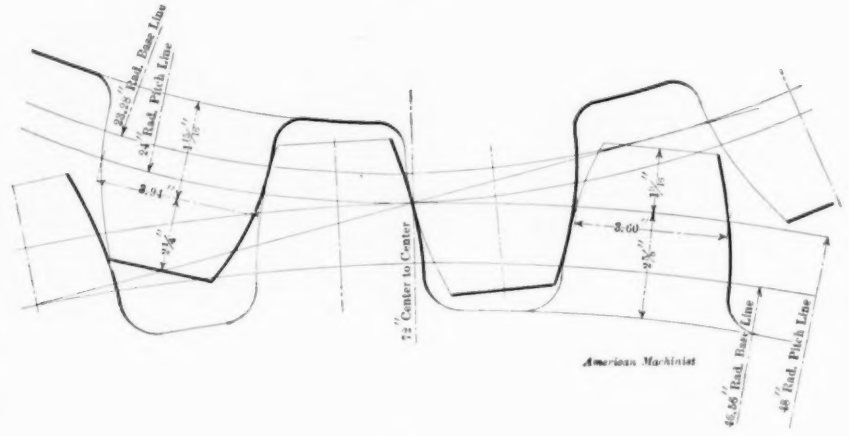


FIG. 3.
HIGH-SPEED TOOTHED GEARING.

tion to this, more or less impact usually occurs, especially when the resistance is of a fluctuating character or the loads are suddenly applied. The effects of this hammering action are discernible by a flattening of the curved faces of the teeth, after which the proper engagement of the teeth ceases and the gear is speedily destroyed.

To prevent this, it is desirable to cut the teeth so accurately that no side clearance or "back lash" exists, and this is now usually done on first-class gearing of even the largest dimensions. Owing to the low elastic limit of cast iron and the bronzes we cannot expect these metals to endure so high a pressure as steel, and steel appears to be the most trustworthy material to endure the highest pressures and speeds. This assertion, however, does not apply to all grades of steel. Soft steel surfaces abrade or cut very readily despite all methods of lubrication, and surfaces of this material should never be allowed to engage in sliding contact. Gearing of soft steel is usually destroyed by abrasion at quite moderate speeds. Rolling-mill pinions of steel, containing 0.3 per cent. carbon, have been destroyed in a few months, whereas the same pattern in steel of 0.6 per cent. carbon has done similar work for several years without distress. Of course, it is necessary to shape the teeth to a proper curve to insure proper engagement and uniform angular velocity.

Some years ago there was required suitable gearing to connect the engines to a rolling mill in this vicinity. The diameters of the wheels were 37.6 and 56.4 inches respectively. They were intended to revolve at speeds of 150 and 100 revolutions per minute and expected to transmit about 2,500 horse-power. The character of the service was such that renewal was a serious matter and long endurance very desirable. A high grade of steel was selected, especially in the pinion, in which the greatest wear would occur, and which, owing to the location, was the most difficult to replace. The pinion was forged from fluid compressed steel of the following composition:

	Per cent.
Carbon	0.86
Manganese	0.51
Silicon	0.27
Phosphorus and sulphur, both below	0.03

The spur wheel was an annealed steel casting:

	Per cent.
Carbon	0.47
Manganese	0.66
Phosphorus and sulphur, both	0.05

The tooth dimensions were: Pitch, 4.92 inches; face, 24 inches. (See Fig. 1.)

These were accurately cut with involute curves generated by a rolling tangent of 16 degrees obliquity. No side clearance was allowed. After starting the mill, it was found that a higher speed was practicable than was originally contemplated. Higher pressures on the teeth were also applied, so that ultimately about 3,300 horse-power was transmitted through the gearing, corresponding to a pressure of nearly 2,100 pounds per inch of face. The speed was variable, but occasionally attained a velocity of 260 revolutions per minute for the pinion, corresponding to a peripheral velocity of 2,500 feet per minute. This gearing has been in constant operation for several years and behaves satisfactorily.

The highest recorded speed for gearing that I can recall is that described by Mr. Geyelin in the Club "Proceedings" of June, 1894. The mortise bevels had a peripheral velocity of 3,900 feet per minute, but the pressure per inch of face was only about 680 pounds, the diameter and speed being made high to reduce the pressure on the teeth. I understand that the lifetime of these bevels is not long. If made of a grade of steel, as previously described, their diameter and speed could

be considerably reduced, and prolonged endurance would be realized.

About the same time No. 1 was installed a similar application was made to another mill, the gear having a different speed ratio, and the angular velocity being lower (see Fig. 2):

	Pinion Per cent.	Wheel Per cent.
Carbon	0.90	0.60
Manganese	0.64	0.64

A much larger set had been previously employed, transmitting about 2,400 horse-power at 750 feet per minute peripheral speed, involving a pressure per inch of face of 3,500 pounds. This latter pair were 4 feet and 8 feet respectively, 7½-inch pitch, 30-inch face, cut with involute teeth of 14 degrees obliquity. (See Fig. 3.)

	Pinion	Wheel
Carbon	0.52	0.42
Manganese	0.55	0.73
Silicon	0.107	0.279
Phosphorus	0.022	0.078
Sulphur	0.02	0.05

These gears have all rendered excellent service, and to-day are apparently as good as at the beginning.

As considerable expense is involved in cutting large gears of hard steel, it is sometimes practicable to rough-cut the gear after it is made as soft as possible by slow cooling, a higher degree of hardening being imparted before final finishing by air hardening or rapid cooling from the refining heat. This is not infrequently done in the case of screws and gears of moderate dimensions. In this event it is desirable to have the ratio of manganese low—say, not over 0.5 or 0.6 per cent.—as a high manganese content seems to impart a permanent hardness that is not readily reduced by slow cooling.

It appears to be practicable to maintain sliding surfaces of steel if one of the surfaces is hard, even if the other is comparatively soft; but for steel gearing for ordinary purposes I would suggest the use of steel not less than 0.4 carbon. If the speeds and pressures are unusually high, a much harder grade of steel becomes necessary. When a small pinion engages with a large wheel, the former alone can be made of high-grade steel approaching to a carbon content of 1 per cent. When extreme speeds and pressures become necessary, the best results will be found by using in both wheels steel having a carbon content approaching 1 per cent., or an equal hardness, obtained by lower carbon and high manganese or other desirable hardening addition. With gearing accurately cut from steel of this character and securely mounted, it is believed that reasonable endurance will be obtained when the product of speed and pressure, divided by pitch, each within certain limits, does not exceed 1,000,000: for example, a speed of 3,000 feet per minute and 1,600 pounds per inch of face, or *vice versa;* for gear of 5-inch pitch, assuming, so far as we know, a maximum speed of 5,000 feet per minute for gear of any pitch, and permissible pressure to be proportional to the pitch.

This statement that speeds and pressures are reciprocal, or as one is increased the other must be reduced, in a fixed ratio, may not strictly be a rational one, but in a broad and general sense it is correct within the usual limits of practice.

It will be understood that such a generalization as herein stated would apply to pinions having a liberal and not the minimum number of teeth.

In the discussion of Mr. Christie's paper Mr. E. Graves gave particulars of three duplicate sets of cast-steel bevel wheels. The pinions are the drivers and are 57.39-inch pitch diameter and have 36 teeth, 5-inch pitch, 20-inch face. The wheels are 74.8 inches diameter and have 47 teeth. The teeth are carefully cut to involute lay-out and are 3.43 inches high. The normal speed of the pinion is 360 revolutions per minute, giving 200 revolutions per minute to the wheel and nearly 4,000 feet circumferential speed on the pitch line. The horse-power transmitted is 1,300. Assuming the entire load to be distributed along the outer end of one tooth, the fiber strain would be 2,100 pounds per square inch at the root of the tooth.

The pinion is mounted on the upper end of a 10-inch shaft, 148 feet long, with a turbine wheel at the lower end. Both shafts extend through the gears and are supported in a massive bridge casting with adjustable bearings. The gears are enclosed in a casing and are lubricated with oil fed under pressure through several jets applied just in front of the teeth as they mesh together.

The gears have been in service for five years, but have not been entirely satisfactory. Their wearing power in the sense of resisting abrasion is satisfactory, but the teeth break. This breakage is confined to the pinion, the nature of the break being the same in all cases, beginning at the large end, cracking around the root and following along the tooth. The quality of the steel in castings is the ordinary commercial article. The widest variation in analysis observed is, in one instance:

Silicon	0.25
Sulphur	0.036
Phosphorus	0.071
Manganese	0.74
Carbon	0.31

Another:

Silicon	0.27
Sulphur	0.03
Phosphorus	0.032
Manganese	0.80
Carbon	0.23

As is to be expected, the softer metal has resisted breaking the longer. In two sets of these gears the resisting work is of a varying nature with sudden and wide fluctuations; in the third instance the working is more constant. This variation of conditions does not seem to have influenced failure, as the teeth have broken in all the sets.

One of the practical difficulties in operating bevel gears of the nature described is the difficulty of holding them so that they will be in proper contact; longitudinal motion in either shaft throws them out of pitch. The most serious problem, however, is in securing and maintaining shafts so that the extended axis-lines of same pass through a common point. The effect of power transmission from pinion to gear is to put these axis-lines out of position, moving them in opposite directions and resulting in end contact of teeth and concentrated load instead of evenly distributing the load along the whole length of tooth. In this particular the question of maintaining bevel gears is decidedly more of a problem than that of spur gears. In this latter case small end motions of carrying shafts produce no effect, while the wearing of bearings is only the shifting of pitch-line, and, as it occurs slowly, it will, within reasonable limits, adjust itself.

As a matter of further interest, I will mention that in this same room with these gears are three other sets of bevel gear having cut-steel pinions and mortise wheel with cast-iron rims. The diameters and ratios of these—speeds, mountings and service—are practically the same as those described, but the transmission of power is 1,100 instead of 1,300 horse-power. The pinions have 33 teeth, 5½-inch pitch, with 20-inch face, the teeth being planed down to 2½-inch thickness on pitch-line. The wheels have 43 teeth. These gears have been in service some seven years. None of the pinions has ever given way; the wooden teeth in the wheels, however, last only from six weeks to two months, an extra rim being kept on hand for refilling and replacing.

Mr. Lewis, in continuing the discussion, said that in regard to the pressures carried by gear teeth, Mr. Christie seems to lay down a rule making the product of speed and pressure constant. This would reduce the load in proportion to the speed, and it seems to me an open question whether that should be adhered to or not. I do not think it has been demonstrated how the pressure of the teeth should vary with the speed. Some experiments, I think, should be made which would indicate that more clearly than has heretofore been done. It is interesting to note his remarks regarding the influence of the hardness of the metal upon the pressures carried, and instead of reckoning the pressure by the inch as so much per inch of face, it seems to me the pitch should also be included, because the face of a gear tooth is very much like a roller, and the pressure carried by a roller varies with its diameter as well as with the face. Some authorities seem to think that it should vary with the square root of the diameter; others directly with the diameter, and I am inclined to

the latter opinion. If gear teeth are proportioned for strength, they are also proportioned for wearing pressure and surface to carry the load.

Mr. W. Trinks said: I wish to call attention to an article on high speed gearing in the November and December numbers of the "Zeitschrift des Vereins deutscher Ingenieure," 1899, by the chief engineer of the General Electric Company, at Berlin, Germany. The experiments show that there is no rule for the relation between pressure and speed; it depends upon accuracy; the load on the teeth may be the higher the more accurately the gears are made. A remarkable method of manufacturing gears was the outcome of the experiment. The curves are laid out on paper three or four times the size of the real tooth, reduced to proper size by photography, transferred on sheet steel, and etched in. Thus the highest degree of accuracy is obtained.

It was found that neither cycloidal nor involute curves gave the best results. Another curve was developed with a view to reducing the sliding motion between the teeth. The article contains very interesting diagrams on this point. By dividing the length of two working teeth into an equal number of parts, the amount of sliding action can be determined and the fact shown that it is reduced to a minimum by these methods.

Another thing shown by the paper is never to place a fly-wheel close to a gear. If possible, have a good length of shaft between. Slight inaccuracies in the pitch of the wheel require acceleration or retardation of the mass, and in order to do this force is needed. This force causes a hammering on the teeth which may break them; in other words, plenty of elastic material should be between the inertia masses and the gears. I feel pretty sure that all engineers will be much interested in the article; it is a valuable treatise on high-speed gearing.

Mr. Christie added: The bevel gears described by Mr. Graves are very interesting and useful as a record. It is much more difficult to obtain satisfactory results with bevels than with plain spurs, as any deviation from correct alinement is fatal to correct tooth action in the former. In this instance, while speed is very high, the pressure on the teeth is comparatively low —about 750 pounds mean pressure per inch of face. Thus the products of speed and pressure in relation to the pitch are considerably below the quantity assumed as a safe maximum.

Regarding the quality of the material, the manganese is too high. While steel of this composition would be moderately hard and wear fairly well, it would be somewhat brittle. It is not surprising to learn that some teeth gave way by fracture. If the relative proportions of carbon and manganese in the steel were reversed, it would be a much better material for the purpose.

Wiring Dies for Shell Work.

BY JOSEPH V. WOODWORTH.

Wiring dies is the common name for dies used to roll over and form the edges of round drawn shells, and, when unusual stiffness is required, enclosing a hoop of wire within the roll. For various purposes it is sufficient to roll over the edge without wire; the dies used in either case are similar. Those here shown were for forming a sheet-brass shell *Z*. The shell was drawn from a flat blank, 2⅛ inch diameter, the blanking and drawing being done in two operations. It could have been done in one by means of a combination blanking and drawing die, but was not, as we had a plain blanking die of the size required. In Fig. 1 is shown the punch and die for drawing the shell.

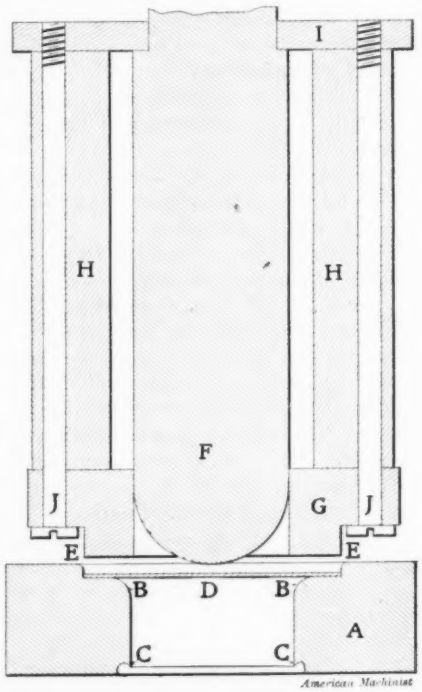


FIG. 1. DRAWING DIE FOR HEMISPHERICAL CUPS.

A plain push-through die *A* is bored out and finished to the size of the outside of the shell, and well rounded at *B B*, with a sharp edge *C C* at the bottom for a stripping edge. A recess at *E E* serves as a gage for the blank and also for locating the punch. The punch *F*, of tool steel, was turned two thicknesses of metal less in diameter than the die, and finished at the point to a half-circle, with a shoulder at the top for the washer *I* to rest on. The lower washer *G*, or blank-holder, fitted within the die *A* at *E E*, and was bored to fit the punch *F*. Four studs *J J* were let through *G*, up through the rubber spring barrel *H H* and screwed tightly into *I*, the rubber being compressed sufficiently to keep the blank from wrinkling while being drawn through the die. The blank is shown in position at *D*.

The edges of the shells drawn are trimmed as shown at *N*, Fig. 2, and they are then ready for the first wiring operation, which consists of rolling and forming the edge, as shown at *U*, Fig. 3. This is done in the punch and die, Fig. 2. A pair of templates, for the punch and die respectively, were made, the difference in size between them being two thicknesses of metal. The die *L*, a round tool-steel blank, first turned and faced to fit the bolster *K*, was roughed out and then finished by hand tooling to the template, and the parts *M M* were polished. It was then hardened and drawn to a dark straw color; the shell *N* then rested true within the die *L*. The punch *O* was fitted to the ram of the press, then chucked and the shape worked out and finished to the template. The knock-out *Q* was then made, and a hole was bored to admit it in the punch *O*, with a shoulder half-way up the stem for the spring *R*. The stem of the knock-out extended up through the stem of the punch *O*, and it was prevented from springing out too far by an adjusting nut at the top, not shown. The lower end of *Q* was worked out to conform with the shape of the face of the punch *O*, which

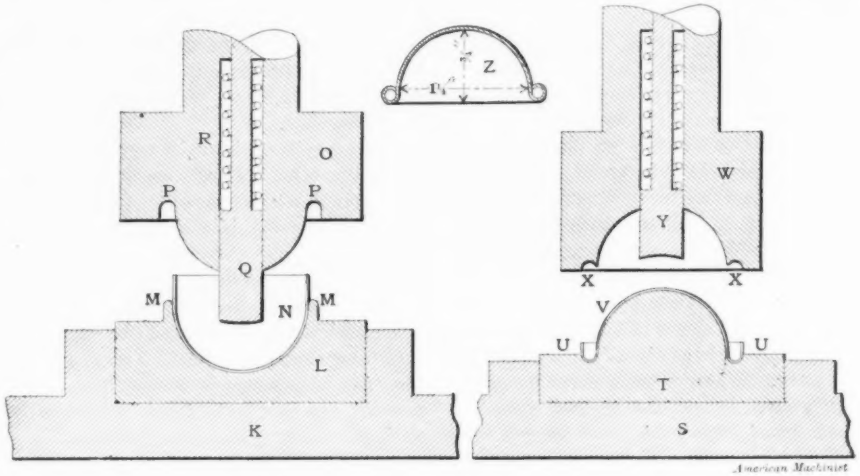


Fig. 2 Fig. 3

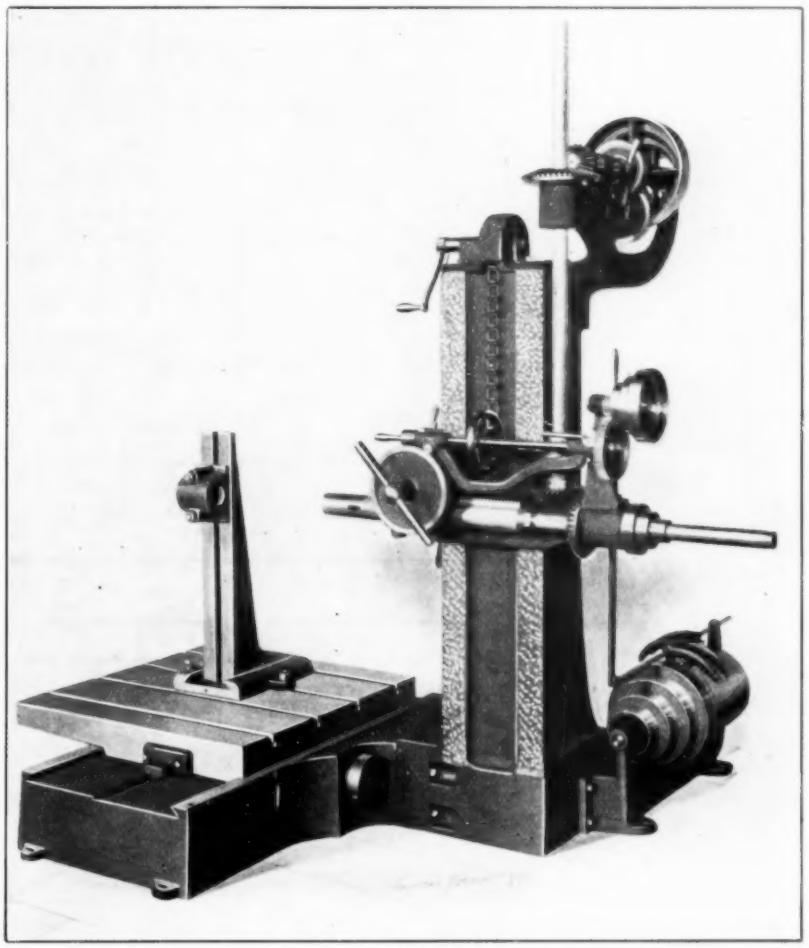
"WIRING DIES."

was then hardened and drawn at the back to a blue, leaving the point *P P* very hard, as all the wear was at these points. When both the punch and die are set up in the press and the shell is placed in position, the punch descends; the edge runs around within the groove *P P* and is drawn and shaped over the lip of the die. This finishes the second operation. The punch and die for finishing are shown in Fig. 3. The die *T* was worked out and finished to the template used for the punch in Fig. 2, except that the depth of the groove at *U U* was only one-half its diameter. This left the die so that the shell would rest within it, as shown. A special template was made for the punch *W*. It was fitted to the press, and the shape, as shown, was worked out and finished, especially at *X X*, which was of the same radius as the points *U U* in the die, leaving a sharp edge on the inside to finish the bend close. After the knock-out *Y* and the spring were made, the punch was hardened and drawn to the same temper as the other.

The punch and die were set, and, when in operation the punch, descending, pressed the metal around at *X X*, finishing it as shown at *Z*. It is in this last operation that the hoop of wire, when used, is dropped within the groove in the shell, and the metal is then drawn and formed over it.

A Horizontal Boring, Drilling and Tapping Machine.

The half-tone herewith shows a new horizontal boring, drilling and tapping machine in such a way as to leave little to be done in the way of description. The work to be operated on is of course secured to the horizontal table, which is 33 inches square and is moved an equal additional distance by rack and pinion, and is clamped securely when satisfactorily located. The movement is by a pin lever inserted in the head of the pinion shaft. The table carries an adjustable support for the outer end of the bar when boring. It can also be supplied with a revolving table for radial or tangential drilling at any angle in the plane. The spindle carriage has all the required movements. It is balanced and has a vertical movement of 40 inches. There are eight speeds of rotation for the spindle, with the necessary feeds and a quick return by rack and pinion. Drilling and tapping of any hole are both done at the same setting. The countershaft is supplied with a tight and loose pulley and also a reversing pulley for backing the taps. The machine as shown will drill and tap or bore all holes in a square 33x40 inches. While all the requirements of a complete machine are provided, it can be furnished in simpler style without back gears, power feed, automatic stop, reversing countershaft or boring bar support. The following are additional particulars of the machine: Greatest hight of drill, 77½ inches; face of column, 12 inches wide; greatest hight from table to spindle, 41½ inches; horizontal feed of spindle, 16 inches; diameter of spindle, 1 11-16 inches; size of table, 33x33 inches; tight and loose pulleys, 10x3 inches; speed of driving pulley, 225 revolutions; floor space, 72x74 inches. The spindle is bored for No. 4 Morse taper. The machine is built by the Hoefer Manufacturing Company, Freeport, Ill.



HORIZONTAL BORING, DRILLING AND TAPPING MACHINE.

Labor Regulations in France.

The Committee of the General Syndicate of Iron Founders of France met, January 24, and considered, among other matters, the employment of children under sixteen years of age. It appears that there is a prohibition against the employment of children under sixteen at the pouring of remelted iron, and a protest to have this removed was unfavorably received by the Advisory Committee of Arts and Manufactures. The meeting decided to circulate a petition for the removal of this prohibition, to be signed by all founders, whether "syndicated or non-syndicated," and presented to the Minister of Commerce.

It is elsewhere learned that the Advisory Committee of Arts and Manufactures mentioned above has drawn up a revision of the decree of 1851 regarding the hours of labor in factories. The changes proposed relate in part to the length of time regular working hours may be extended where the men are engaged in some duty supplementary to the regular work of the day, such as care of engines, furnaces or machinery.

Solid or Built up Dies—A Proposed Die and its Substitute.

They had finished their experiments, secured their patents and made all but a few of the final arrangements for the manufacture, on a fairly large scale, of, to them, the newest thing out. They had been for a long time successful manufacturers of articles of materials not requiring the use of metal cutting dies and formers, and this part of the equipment was one of the last to be provided for—in fact, was not provided for; because, if it had been, in all probability someone else might be writing this, leaving me to continue my experiments on melting tool steel, which I may be able to tell you about in the near future.

It is possible that their intention was to have the first die made outside of their own factory. At all events, their represen-

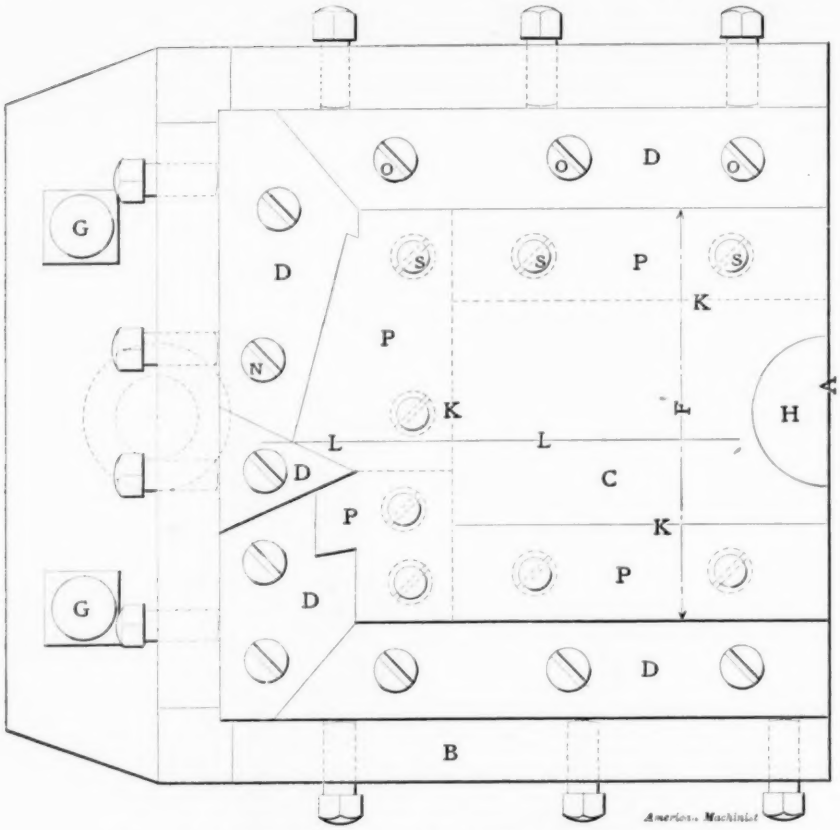


FIG. 1. PLAN OF ONE-HALF OF DIE FOR CUTTING THE ENTIRE PIECE.

tative called at the office and made his formal request. A few preliminaries were arranged, after which he was turned over to me, to whom he gave details of what was required in the finished form, which required a piece of tin, 5 inches wide by 13 inches long, with the ends cut so as to form certain angles and sizes. The sides or edges of the blank were straight and parallel. Both ends were cut the same, and are shown in Fig. 3, one end resting against the stop *H*.

The original intention was to have a punch and die made and blank out the required piece, and I made a drawing showing how the punch and die would look, Fig. 1 being a plan or top view, and Fig. 2 a section on *L L* of Fig. 1. Both views show only one-half of the length, the line *A* being the center, the other half being the same as the one shown.

A is the center line crosswise of *P* and *D*; *B*, cast-iron die block; *C*, cast-iron top block or punch holder; *D*, tool-steel pieces for the cutting edges of the die; *P*, tool-steel pieces for the cutting edges of the punch; *E*, bolster plate; *F*, clamping bolt for bolster plate; *G*, screws to clamp *B* to *E*; *H*, round or square shank on *C* to fit the slide or gate of press; *S*, rib on *E* for *B* to rest on; *I*, space between *B* and *E*; *K*, boss or abutment for holding the pieces *P* out to place; *N* and *O*, screws for holding *D* to *B*; *S*, screws for holding *P* to *C*. The steel pieces *D* are adjusted, when required, by the set-screws shown on the sides and end.

As the opening through the bed of the press to be used was only about 9 inches long, it was necessary to dispose of the blanks either by a knock-out or a space under the die, and as the press did not tilt, the space *I* was provided, and the blanks were removed by hand.

Before the drawing was completed it occurred to me to cut the stock the correct width and length and trim the ends to the proper shape. After finishing the drawing for the blanking punch and die, as shown in Figs. 1 and 2, I made the drawings as shown in Figs. 3 and 4, which is as much a shear as a punch and die. Perhaps trimming punch and die is as good a name as any.

Not wishing to upset the plans as arranged and intended to be carried out by the management, it was decided best to call the representative, when it was explained to him that buying his tin either cut to size or in multiples of the size required, and shearing it to size himself, would be quite a saving in material. Attention was called to the fact that while he would have to shear his tin to size, and change ends of the piece in trimming, yet he would undoubtedly be able to secure as speedy results as he would were he to blank them out complete. His attention was called also to the quite apparent reduced cost of making the trimming die, also the difference in expense of keeping sharp and, when worn out, of renewing; also the greater liability of the larger punch and die getting out of line and causing, besides the accompanying fireworks, a cessation of the good work, the removal of the punch and die, followed by a trip to the grind-stone, and in some cases a general opening of doors and windows to facilitate the escape of the sulphurous

FIG. 2. VIEW OF HALF OF PUNCH AND DIE.

odor that sometimes very suddenly accumulates at such times.

While the representative (in this instance he was the superintendent) was neither a machinist nor a die maker, he was a mechanic; and it was not necessary to hit him with an ax in order to make him see what I called a good substitute for what he wanted. In fact, he did not

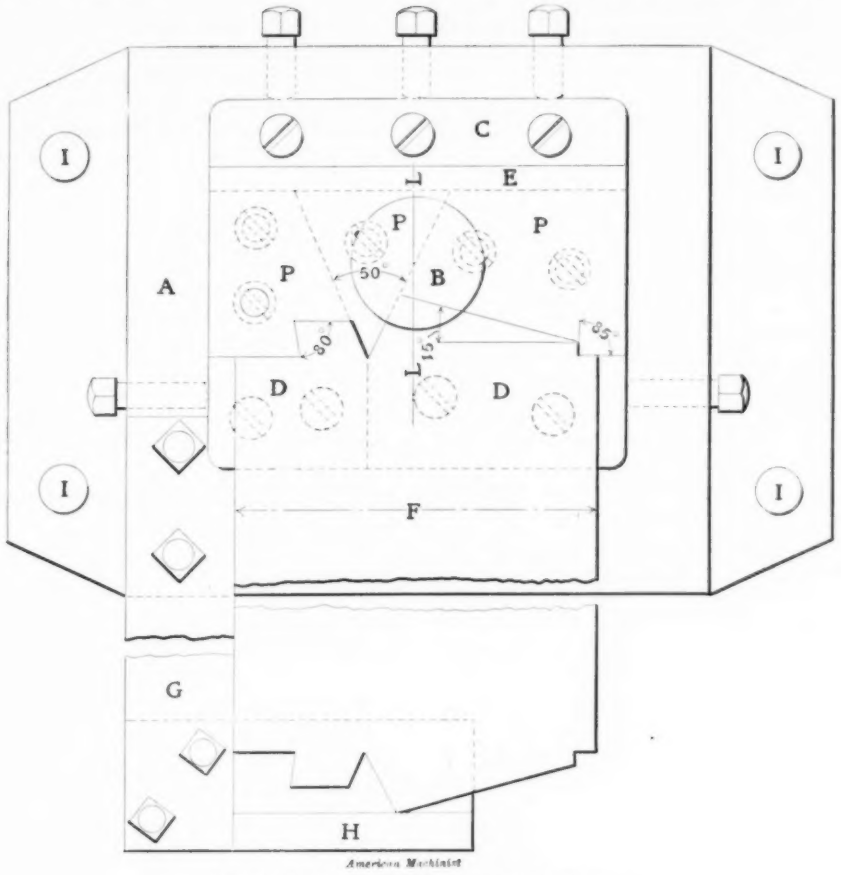


FIG. 3. PLAN OF DIE FOR CUTTING ENDS ONLY.

care to have anything changed, not even to cut off both ends at the same time.

Fig. 3 is a plan or top view of the die as made. Fig. 4 is a section of Fig. 3 on line *L L*; *A* is the cast-iron die holder; *B*, cast-iron punch holder; *C*, heel plate on the die; *D*, tool-steel working parts in the die; *E*, heel plate on the punch to hold the cutting edges of the punch up to the die; *F*, width of blank; *G*, set edge; *H*, stop for end of blank; *I*, holes to screw down to bolster plate; *P*, tool-steel working parts of the punch.

As the ends had to be cut to certain angles they are also shown. Fig. 3 shows the shape of the five pieces that compose the cutting edges of the punch and die. Fig. 4 shows die holder *A* milled out to receive piece *D*, and, as the tendency of *D* is to move away from its work, it will stop in the corner and remain, backed up by *A*, the opposite side being also milled out to receive *C*, which is adjusted when necessary by the set-screws.

The steel pieces *D* and *P* are finished before hardening almost to size, and after hardening are finished to a fit by grinding, and when in place are used as jigs to drill the holes for the screws.

While I am no stickler for built-up dies, unless one gets a more certain control of the steel, I am quite certain that a blanking punch and die, like Fig. 1, will be safer to make and use than one made out of the solid, and, furthermore, that Fig. 3 puts Fig. 1 quite decidedly in the shade.

After the substitute was finished it fell to me to go and set it in the press, at which time I called their attention to the possibility of thus being able to trim not only one, but as many as three at once, provided they kept the cutting edges sharp.

G. SCHNEIDER.

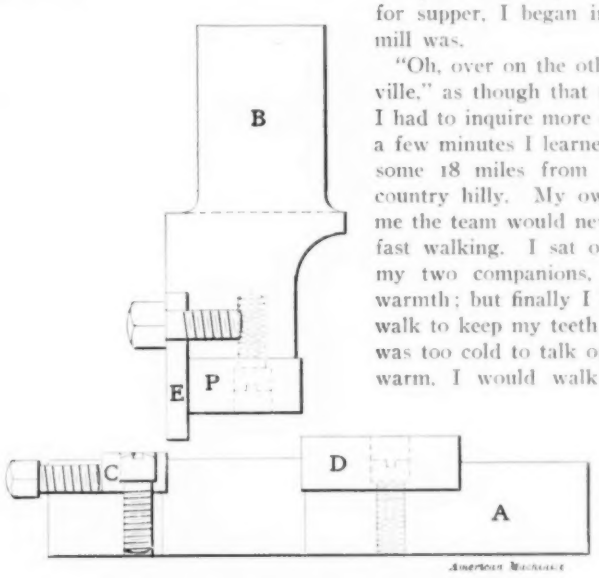


FIG. 4. DIE AND PUNCH FOR ENDS ONLY.

Mr. Richard Moldenke, secretary of the American Foundrymen's Association, announces that the sixth convention of that association will be held at Buffalo June 4 to 6. The Niagara Hotel has been secured for convention headquarters.

Echoes from the Oil Country.

OUT OF THE BEATEN TRACK.

"Osborne, I guess you will have to do this job yourself. Here are Jenkins and his partner after some pipe and bolts. They have their load all on, and they want a man to go with them and change the eccentric on their engine, so it will run the other way. They are moving their sawmill to a new place, and they can't set up as they were before, owing to the lay of the land. I was hoping that Billy or Sammy would get back before they were ready to start; but there isn't a sign of them yet." It was Mr. Smith that was talking, and it meant a drive into the country—"for my health," as the boys put it.

I quickly got some chisels, a hammer, two files, a scratchawl and a center-punch, and a piece of steel, to act as a drift to back out the key in fitting, tied up in a piece of bag; felt that my rule and calipers were in their usual places in my pockets, climbed into the wagon, and we started.

It was in October, and about 5 o'clock, but as neither of the men had on overcoats (indeed, one of them didn't have on any coat), I judged we were not going far. Until it got too dark to see, I was quite taken up with seeing the country, as we were going in a direction that was new to me; but after a couple of hours had passed and my stomach began asking for supper, I began inquiring where the mill was.

"Oh, over on the other side of Durgeyville," as though that told me everything. I had to inquire more definitely, and after a few minutes I learned that the mill was some 18 miles from the shop, and the country hilly. My own observation told me the team would never take a prize for fast walking. I sat on the seat between my two companions, and so got some warmth; but finally I had to get out and walk to keep my teeth from chattering. I was too cold to talk or whistle. To keep warm, I would walk on ahead until I came to a crossroad, and then walk back to meet the wagon. When warmed up I would get in and ride.

About 10 o'clock we passed several houses that they said were Durgeyville. "Most folks call it Bug Town," was added. Then we struck down off the hill and into the woods. Dark! I couldn't see the horses. One man walked. I had to hold on with both hands, but I was afraid to try walking, for fear of wrecking myself or getting lost in some hole. Finally we stopped and I was told we were at the

mill. I took the statement on faith, as I couldn't see anything.

After laying off their load, Jenkins told me he would take me home with him, while the other man would take care of the team at his place. After several invitations to Jenkins to go a little slower until I caught him again, I managed to get out of the woods, and after climbing a hill we got up to the house for supper; time, 11 P. M.

The house was rather small—one large room, the kitchen and dining-room combined, and one bedroom and a pantry downstairs; upstairs unknown. Family: Mr. and Mrs. Jenkins, Sr.; Mr. and Mrs. Jenkins, Jr.; several young men and girls, and several neighbors' girls that had come to stay all night, thinking that Mr. Jenkins would not be back.

After a hearty, warm supper I began to feel better, but very sleepy, and I began to wonder where I was to sleep. That did not seem to worry my host any, though. As the young people found places and vanished, he took up a lamp and led me to the pantry, and there, surrounded on every side with household supplies, and dishes, and milk pans full of milk, was my bed. Over me hung hams and bacon, dried corn and onions. From behind the partition came giggles and suppressed laughter. With a wave of his hand, I was invited by my host to eat all I wished, if I got hungry, and left to gentle slumbers in the funniest place I had ever slept in. I awoke late in the morning to find a woman reaching over me after something; a minute later another one was after something else, and suddenly a thought struck me. How was I going to be able to get up and dress with all those girls and women running loose? I am a modest young man, an orphan, not used to the society of unknown ladies, and I began to think I would have to stay in bed all day, when the elder Mrs. Jenkins came in, and without any preliminaries she remarked, "You can get up now." She then closed the door. She evidently understood modest folks. I lost no time in dressing.

After breakfast we went down to the mill, and it did not take long to locate the new keyway in the eccentric. A bolt and a piece of block held it while I chipped the keyway. A few nails made a good vise to use in fitting in the key, and soon I had everything in shape for them, and was ready to return, but I found I must go to dinner first. The partner took me to dinner, and after dinner hitched into a buggy and we started back to the shop. We stopped at the mill while they figured out some more things that were wanted, so it was after 2 o'clock before we got under way for good.

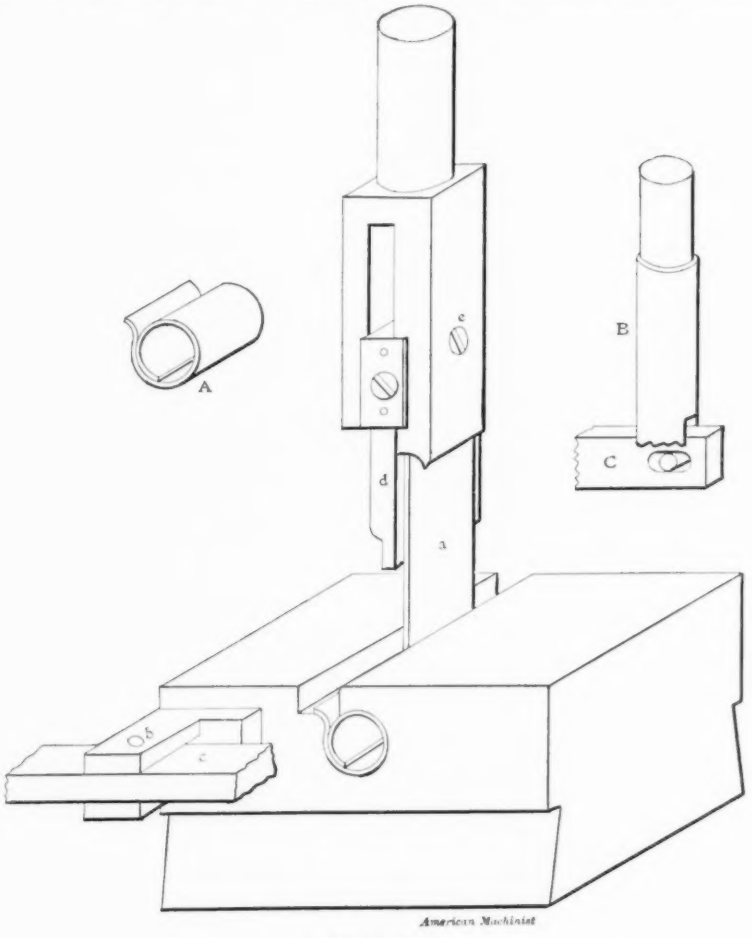
After we got clear of the woods and up on the hills, I found the wind was blowing fiercely and very cold. We were sitting on a horse blanket, and this I took and wrapped around myself to keep from freezing; and thus in state, and surrounded by an odor not usually associated with machinists, I returned with comfort, if not with dignity, and was let off at the shop just in time to be greeted with laughter by the men, as the whistle was blowing 6 o'clock. W. OSBORNE.

A Curling Die.

BY GEORGE W. FREEMAN.

The die shown in the sketch curls or rolls sheet stock into such shapes as shown at *A*. It can be used for sheet stock in a great variety of shapes and sizes by changing its form to suit.

The bending is done in the middle of the die, *a* being a strip in position ready for the beginning of the operation. The piece already bent and appearing at the front edge of the die is placed there, out of its correct position, to show how it lies in the die when the bending is finished. The bending is done upon the small end of the mandrel *B*, which lies horizontally in the die and is moved back and forth by the lever *c*. After the piece is completely curled, the mandrel *B* is thrust toward the back side of the die and withdrawn again, which movement carries the curled piece out of the die and permits it to drop off the mandrel upon its return. The loosely sliding piece *d* is an essential part of the apparatus. This descends with the piece *a* until it enters and bottoms in the opening of the die, where it stands as a backer for *a* and keeps it straight while the punch, still descending, completes the coiling of the piece and the final bending of the projecting lip. As the punch ascends, the piece *d* is not picked up until it reaches the lower end of the slot, as shown, when it is prevented from dropping out by the screw *e* on the side, the point of which projects into a slot in *d*, the upper end of which is closed. The hole in the end of the lever *c*, it will be noticed, is elongated to permit the required movement. This elongation might be made in the hole at the fulcrum of the lever where the pin *b* goes through.



A CURLING DIE.

Letters from Practical Men

A Dipping Arrangement for Small Brass Articles.

Editor American Machinist:

I have on my desk a letter from a mechanical friend who has charge of a small shop making fancy brass novelties. He is a smart young man and has had up-hill work in his present undertaking. His letter runs about as follows: "I come to you for help once more. You know I have my plating and dipping done outside, which is all right, but I have a lot of samples to try, and I don't like to send so few ounces to another town to be dipped, or even plated, and then returned and submitted for approval. Now

can't you give me an idea to help out?" My friend is a reader of the "American Machinist," and I thought that there might be others in small shops who would be assisted as well as himself by a little information in this line.

First get a jar holding about five gallons. Set it in a sink or any water tank so that it will be about two-thirds immersed. The water should be clean, and if possible running water. Into the jar put three gallons of oil of vitriol, 66°; then carefully pour in 1 gallon aqua fortis, 40°. Add 2 fluid ounces of muriatic acid. Be very careful not to inhale the red fumes. Let this mixture stand 24 hours, then set it in a tub of water, and it is ready to use, and if one is careful not to drop stray pieces of brass in it, it will last many months. Above all things keep iron out of it, and keep the jar covered. Now get a tin box about eight inches deep and a foot square. Fill with nice clean pine sawdust and put it on the steam pipes or back of the boiler so as to be warm all the time. Take your work on brass or copper wire, immerse in jar quickly, remove and place in the cold water, then thoroughly rinse and dry in the hot sawdust.

The above is intended only for sheet brass and copper; cast brass requires different proportions of acid in proportion to the percentage of spelter in the metal. Should the editor indulge me so much in the future, I will let you into some of the so-called mysteries of nickel and silver plating, which should be known to all superintendents, as platers have a way of looking wise and being altogether too independent.

IRON QUILL.

What the Lathe Hands Think of the Compound Rest—Erratum.

Editor American Machinist:

In the article entitled "What the Lathe Hands Think of the Compound Rest" (No. 7, page 182), there is a slight mistake—in the place of 23 degrees it should read 29 degrees. H.

Interchangeable Gearing.

Editor American Machinist:

I beg to call your attention to a slight error in your excellent article by Mr. Lewis, which appeared in the "American Machinist" No. 9. I refer to the expression: "$\frac{1}{n}$ is equivalent to $\frac{p}{\pi}$, or 0.3283 p"; also a little farther down the column: "Letting $a = 0.3283$ in equation (1)," etc. This is of course a typographical error, and should in each case read 0.3183.

Providence, R. I. GEO. H. HALL.

A Test of Files.

Editor American Machinist:

Having had a lot of files to test, I found that an average man with a new 14" bastard file can remove 1 cubic inch of machinery steel each hour, if he works faithfully. The only condition being to remove steel, the work was done on the end of a bar 1" square.

This may interest you or your readers.

A. D. PENTZ.

Elizabethport, N. J.

Modern Mechanical Opportunities.

Editor American Machinist:

That picture in the advertisement on the front cover of your issue No. 8 is an innocent-looking thing, but it is pretty sure to make trouble. How many disks are wholly or partly visible there? There will be more or less time spent, which somebody may be demanding pay for, in trying to count them, and then all will not agree as to the result. I've had a dispute with a fellow about it already. I tried first to count them by my eye alone; then I took my finger as a guide to help me, then I took a sheet of paper and eclipsed them all, and slid it off gradually and counted the disks as they were successively uncovered, and I got a different number every time. Finally I took a pen and made a dot on each one as I counted it, and now I have to get another copy of the paper, as it is claimed that my marks at two or three of the spots make it impossible to count fairly any more. I know enough not to tell anybody how many I counted.

Anybody can easily count more than a hundred and thirty of those disks, and if they were all cut off by one hack-saw blade, then I must say that they make better hack-saws than they did, say, thirty or more years ago, when I used to run them. The steel is different, too, and that may make some difference in this case. Both I and the saw would at one time have been worn out by the time a single piece was cut off.

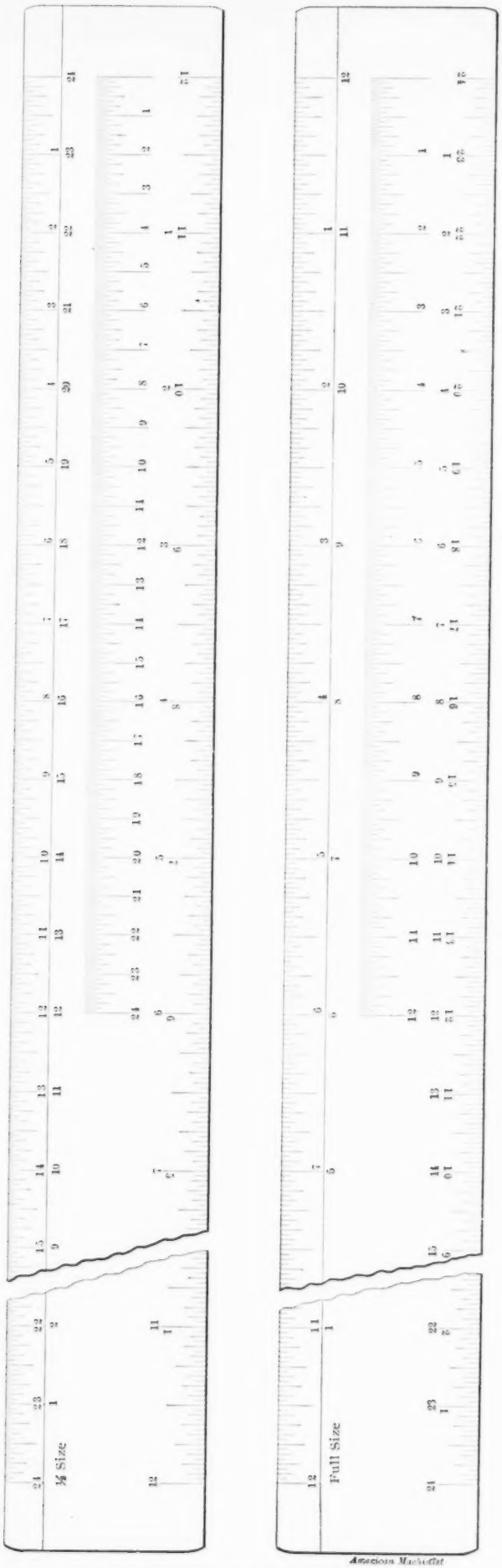
This exhibit of what a modern hack-saw can do is only one of a thousand examples that might be cited of the improved facilities now available throughout the mechanical world. Everything that has long been in use has been improved, and multitudes of new appliances and products have arisen to aid and to stimulate the modern mechanician. In the presence and possession of these things we need not for an instant have doubts as to our future. The workers of the world were never less in danger of working themselves out of a job. Although we may never see more than a short distance ahead in the path of progress, it is as unending as ever, and we are bound to traverse it faster than before.

I often think how we ought to pity the poor inventors of the days that are gone for the stern restrictions imposed upon them in the scope of their accomplishment. It must have been in the olden time a bitter task for the inventors, although they may not have realized the bitterness of it, to curb their imaginations to travel within the limitations of the mechanical possibilities of the times. In the days of antiquity there must have been lots of things that they could not dare to allow themselves to invent, and antiquity is not far away. How pitiable, for instance, would have been the plight of an inventor if to him had come, say only fifty years ago, a complete conception of the modern bicycle. It would have been as impossible then to produce as perpetual motion, and the vision of it would have been a nightmare. Just think of it. No mild steel or the things that we make of it, no steel tubing or the steel rod for wheel spokes, no chains and sprockets, no rubber tires, no balls for the bearings, no tools and no knowledge of the means of making any of these things as we now make and use them.

Speaking of the balls for the bearings, I am tempted to indulge in a little self-pity at their suggestion. There was a time when I was stuck completely as an inventor for the lack of them. I labored long, in my mind almost entirely, to produce a perfect universal ball caster for furniture and such things, one that would move with perfect ease, and that would move in the precise direction desired, without having to do any preliminary swinging around, which is such a nuisance with the casters not universal but in universal use.

My idea was to have a big ball as the principal member of the concern, and over this, attached to the leg of the chair or table, an inverted hemispherical cup of larger radius than the ball, and the space between the ball and the interior of the cup filled with little balls. There would be a cap attached to the cup, which would hold the big ball from dropping out, and also form a circular channel which the little balls would be able to traverse freely. It is easy to see how beautifully everything would have worked. The big ball would have worked easier than rolling off a log; and the little balls, as fast as they were released from one side, would have hurried by the circular channel around to the other side and have got right to work again. Alas! there was no ball factory in existence, and it would have cost me a hundred dollars to have produced something only remotely approximating what could now be made for ten cents. I made a pretty good cup, according to my standard of workmanship, and a big ball, and then I tried to use lead shot for the small balls, and there I got one of my lessons about the imperfections of things. The shot were not all of a size, they were not round, they had flat spots, and they were ready to develop others on the slightest provocation.

Now that we have what you may call perfect balls *ad libitum*, I do not know that anyone is yet making for the market satisfactory ball-bearing casters, but somebody certainly should be making something of the sort. The modern produc-



A HANDY SCALE FOR DRAFTSMEN.

tion of steel and other balls so cheaply and so good is opening a most prolific field for the inventor, and it is astonishing how wide and satisfactory is already their employment. They are used for the most diverse purposes and with an almost limitless range of sizes. On the latest American-built Russian cruiser, "Variag," they are used for the turret bearings and on the gun-mounts, and at the Paris Exposition a watch was exhibited with ball bearings for its pivots. They are used as valves in injectors, pumps and air compressors, in crushers, in elevators, in large automatic shovels (Thew's) in drawer runways, in windmills, wagon bearings, railroad car journals, umbrellas, and other places "too numerous to mention," and this is only the beginning. The perfect steel ball offers unlimited possibilities to the inventor, and we may be very sure that he will avail himself of them.

TECUMSEH SWIFT.

A Handy Scale for Draftsmen.

Editor American Machinist:

Believing as I do that making drawings is a necessary evil in nearly all manufacturing operations, and that more time than actually necessary spent in such work is worse than wasted, anything tending to relieve the mental strain, as well as to expedite the work, is valuable. To this end, as my work is usually either half-size or full-size, I devised the rule shown herewith, and had it made by Theo. Altenedeer & Sons, Philadelphia, who have my permission to make duplicates for any desiring them.

This rule differs from those in common use by being always right end first, although having two scales, and having the figures always right side up when in use, reading from right toward the left in all cases, thus avoiding cross-hand work, and on the bevels reading both ways. It is fully divided, with but one scale on an edge, thus avoiding confusion; is of reverse bevel, which makes it easy to pick up; and when setting off a measure on the far side of the board, and it is difficult to see clearly over the beveled edge, the rule is simply rolled up on its working edge, when the graduation on its under side is brought into view with its figures erect for easy reading and the rule in proper position for use. Should the rule get turned end for end on the board, it is only necessary to turn it the other side up (this being the extreme case), press the rule down so that it rests on the beveled edge, when the graduation is in position to use, and the figures right side up to read, and you are looking at precisely the same angular surface as in its regular use.

There is also a central scale on each side, extending 6 inches of the length and graduated to read as one-half of that on the adjoining bevel. This scale is for use in setting compasses by direct reading, and thus avoid the mental arithmetic of halv-

.ng such measures as 3 27-32 inches, with the consequent possibility of mistakes and the distraction of one's ideas from the work in hand. C. S. BEACH.

Spoiled Work.

Editor American Machinist:

Lots of the boys have put in articles from time to time telling of the good jobs that they have done, and how they have done them, and I think it is about time some of us came forward and told of the bad jobs we have done and the work we have spoiled. Now, I don't like to be the one to break the ice, and wouldn't be, either, if I didn't come across so many of the jobs the other fellows had spoiled. A case came up a few nights ago that I think will bear telling. We had a repair job come in. It was a large worm gear to be cut. It was a break-down job, and was being pushed for all it was worth. It was too large a job for the Brown & Sharpe automatic, when used in the regular way, and so we put two men on the job, one to feed the gear down on to the cutter and the other to trip the clutch and let the feed revolve the gear for the next tooth. The two men were put on opposite sides of the machine, with strict orders not to do any talking, except when No. 1 withdrew the bar from the cutter, he would say "Now," and then No. 2 would trip the clutch.

Things had gone along nicely well into the night (it was an all-night job), when a hot chip from the cutter struck No. 1 in the eye. (By the way, did it ever seem to you that the eye has an attraction for hot chips?) No. 1 sings out "Ough," No. 2 trips the clutch, and—well, there is no need of my telling anything more about it.

Another different kind of a spoiled job was one that came under my observation some years ago. It was the main casting or core for a large armature; we had it on the Bement & Miles mill, and were boring the hole for the shaft. The hole was, if I remember right, some 8 inches diameter, and the core was about 3 feet long, or, rather, high, as it stood on the mill. A day man had run one cut through and found the hole taper, a little smaller at the bottom. He set the head over a trifle and started his next cut just as the clock struck six. He told the night man what he had done, and went home. The night man started the mill and ran a cut clean through the job, calipered his hole and found it a sixteenth larger than the size called for at the bottom.

You can imagine the commotion there was over the job when the foreman came in the next morning. The cost of the casting, with the work already laid out upon it was over $500, and it was of such a character that it could not be bushed, and the only remedy would have been to make a new shaft; but, for the reason that the armature was one of a set of five which must be alike, it could not be done. Both men were fired on the spot, but that did not seem to help the job, or the feelings of A. P. PRESS.

Arrangement of Views and Dimensions on Working Drawings.

Editor American Machinist:

It is of first importance in working drawings that all details be made from the same point of view, if possible; that the various plans, elevations and sections appear in detail exactly as they would in the general drawing, if the balance of the structure were assumed to be transparent. Many draftsmen have an aggravating habit of turning details upside down, sideways or wrong end foremost, under the mistaken impression that they may be dealt with as if each stood alone in the world and without relation to anything else whatsoever. They will draw a shear in front view and right-hand elevation, and then proceed to detail the knife-holder as it appears when seen from behind, and the housing as seen from the left. One detail is given with a plan, front and right-hand view; another with a plan, back and left-hand; still a third with bottom, rear and right-hand views.

The ease with which a machinist will be able to read a drawing depends very much upon the correct arrangement of the views, but of possibly still greater moment is it that they be properly figured; and it is in this regard that the draftsman offends most frequently. In place of being grouped systematically and in some fixed order of sequence, the dimensions are scattered impartially all over the sheet, as if the desired allotment were so many to the square inch, like seed sown broadcast. Some dimensions are given six or eight times, in as many different places, while others which ought to appear prominently are not to be found at all. Rightly arranged, the figures upon a drawing follow a well-defined method, in which the greater includes the less; by which is meant that the smaller dimensions are nearest the views to which they relate, and so are within the lines of the larger ones that are placed at a greater distance. The drawing will usually appear far more clear if the dimensions are placed around the various views, rather than directly upon them, by means of witness lines projected out from the parts it is desired to designate. Witness lines should never be crossed by dimension lines where it is possible to avoid it, and this is one sufficient reason for placing the smaller dimensions inside the greater ones. The total dimensions are made up of a number of sub-totals, and these, in turn, of still smaller units, down to those which call for no further subdivision. Important dimensions should always be given directly, from centers to finished surfaces, or between two surfaces which require to be in fixed relation to each other. Many persons have the awkward fashion of figuring from the outside of a rough casting back to bolt holes or finished surfaces, thus compelling the machinist to get the essential dimensions by addition or subtraction, in place of direct reading. Shafts connected by fine pitch cut gearing are often figured, not in relation to each other, but in regard to some utterly unrelated surface which happened to strike the draftsman's eye as a convenient place to hang dimensions on. Some few works avoid these faults by giving none but finished dimensions on casting details, drawing accurately to scale, and allowing the patternmaker to measure the drawing. This saves time in the drawing-room and makes things clearer to the machinist. This method leads to a preference for scales which are divided into some of the binary fractions of an inch—eighths, sixteenths, thirty-seconds, etc.—which consequently can be measured by a common rule. Others, again, insist upon working only to figures, and purposely use scales which are not to be found outside of the drawing office. An all too common fault is the placing of figures relating to a single constructive feature upon a number of different views, in place of grouping them together. For example: A cylinder will have its counterbore diameter given on one view, the depth of it on another, the bolt circle on a third, while we must seek still further for the size of the bolts, and look yet again to learn whether the holes are to be drilled or cored, the bolts to be rough or finished. Should the bolt be a special form requiring a detail, it may be given, but in some far-off corner of the sheet where it would be least expected.

The vast number of wholly unnecessary fractions which ornament some drawings cause about as much waste of mental effort in the machine shop as any single item that could be mentioned. The machinist works upon very fine lines when occasion arises, but this fact does not justify deluging him with a string of dimensions involving sixteenths and thirty-seconds that are altogether uncalled for.

The style of figures and letters used has also much to do with the shopman's comfort and peace of mind, and few draftsmen realize the need of clearness in this respect. The rule of the drawing office is plainness and distinctness, but it is not as fully observed as one could wish; and small, sloping, crowded figures and fractions are still too much in evidence on a numerous class of shop drawings. Figures and letters on drawings should be fairly large, of full open form, free from any attempt at ornament or shading; the simplest possible style, of which the perfectly vertical is considered the best, and the width should be about as great as the hight, avoiding cramped or angular forms. The terms of a fraction should be written one directly over the other, with a short horizontal bar between them, and separated by ample space so that a slight blur in printing will not merge them one

into the other. There is greater risk of spoiling work by mistaking $\frac{1}{8}''$ for $\frac{1}{4}''$, or $\frac{1}{64}''$ for $\frac{1}{16}''$ than where the error is of a greater amount. In the latter case it is more likely to be discovered.

That a large percentage of shop drawings are faulty in the above-mentioned particulars is a fact patent to all who have had an extended experience in using them, and, at times, other than shopmen feel impelled to murmur at the draftman's sins of omission and commission. One often looks in vain for such a desirable piece of information as the stroke of a cylinder, a lever, or other moving part of a machine. The distance from the edge of a shear knife to the foundation bolts is an essential requirement in locating a foundation for the same, and yet it is often missing from the drawings. A well-known firm, who are builders of an extensive line of small steam engines, repeatedly furnished their customers with drawings on which the crank shaft had no given relation to any of the anchor bolts, and, since they have reformed in this respect, they give the distance from the crank shaft to the edge of the bed-plate, from the latter to one bolt hole and from this in turn to the others in succession, still compelling the purchaser to do a little calculating to arrive at the dimension which, to him at least, is of first importance. GERALD E. FLANAGAN.

Rectangular Emancipation Without the Misery.

Editor American Machinist:

I have always been hampered by a peculiar faculty for getting myself into trouble and others out; so here goes a dash at A. L. De Leeuw in No. 8 of the "American Machinist," in his "Rectangular Emancipation and Solid Misery."

In getting up new machines, fixtures, jigs, etc., according to specified requirements, there seems first to appear to me a dense haze, and conglomeration of mechanical motions, clamps, chains, holding devices, etc., etc., and so on, and all very much in the way of each other; and the great worry of executing the contract consists in getting the best selection for my purpose extricated from the mass of good, bad and indifferent propositions. Sometimes days are consumed in this kind of a struggle, unless the office boy (as likely as anyone else) drops in with an emancipation proclamation, and with his little lamp throws a ray of light upon the very object, and there you are; and quite likely in our excitement, enthusiasm, selfish narrowness, or some blind interest, we neglect to even say thank you.

When I had read De Leeuw's article, down came the usual conglomeration; and in it I could seem to see a lot of more or less incongruous speed-regulating aggregations, some in memory dim, and some being reasoned out; but not having anything in practice on these lines, I found myself floundering to very little purpose; but there are others, and these same others have had some experience with speed regulation.

What is the matter with the arrangement, in the same issue with Mr. De Leeuw's letter, page 203, by the General Electric Company, Schenectady, N. Y. These people can doubtless solve the whole mystery as to the location of that motor, as electric driving is now practically universal in their works. Perhaps the Niles Tool Works Company, 136-138 Liberty street, New York, may be able to show our friend where that motor is by its speed controller, or G. F. Evans, 85 Water street, Boston, with his friction cone pulleys. BOW-PEN.

Burlington, N. J.

An English Workman on Premiums.

Editor American Machinist:

As an English workingman I was pleased to see in the "American Machinist" No. 3 a letter from the firm of Tylor & Sons, Ltd., saying that they had adopted the plan so warmly advocated in your valuable paper, namely, premiums to workmen for suggestions. To my mind, however, they did not go far enough, inasmuch as they omitted to state whether they were themselves satisfied with the results, and to what extent. I am sure that it would have proved very interesting to many employers of labor in England, who are perhaps only awaiting a lead in the matter. Speaking from my own and shopmates' view of the question, we cannot help feeling that it would be a capital thing, both in their own and in their employees' interest, and would be welcomed and supported by all intelligent workmen. The employers on their part would be surprised at the latent power of their men, awaiting only the necessary encouragement and incentive to assert itself. It is a matter of common knowledge among working men of England how conservative employers and foremen are, as a rule, in receiving practical suggestions from their men. A snub is, as a rule, the only reward. I hope that English employers will give the subject the attention it merits and strike out on new lines, accepting the co-operation of their men, and thus getting full value for money and not allowing abilities to lie dormant that should be exercised to their mutual good. J. H.

Birmingham, England.

Another Method of Indexing Unusual Numbers.

Editor American Machinist:

I have considerable lathe work to do, namely, small taps, dies, gages, etc., and my lathe not having any graduations on the cross-slide, I decided to put one on. I turned a collar to fit on the shank of the screw just inside the handle; a thumbscrew allowed for the setting to zero mark.

The milling machine was arranged for cutting the lines, when it was found that there wasn't any circle that could index 125 teeth. I looked over the table and saw that to cut 25 teeth you would index one turn and 12 holes, or 32 holes on a 20 circle; then to cut 125 teeth, take one-fifth of 32 holes, or $6\frac{2}{5}$ holes (or spaces).

I then made two pins to fit in the holes of index plate, one with head four-fifths of the space, minus the diameter of the index pin, in diameter, and another two-fifths of space smaller. Then by moving the index pin until it dropped over the far side of the large pin in the sixth hole I got $6\frac{2}{5}$ spaces. The next cut was taken by moving the index pin against the near side of the pin in the seventh hole. Every time the index pin came to the hole as stopping place, a larger cut was made; this gave a long line for every five one-thousandths.

This method can be used on quite a number of cuts not given on the table.

Glenville, Ohio. D. I. E.

Gas Engine Gaskets.

Editor American Machinist:

Relative to "Gas Engine Gaskets" by Mr. Tygard in the "American Machinist" No. 7, I have had some interesting experience, which I beg to submit for the benefit of your readers. I find that asbestos of itself is not satisfactory for a water joint. I use a paint composed of finely ground graphite in linseed oil, as Dixon's Pipe-Joint Compound, and apply it at a temperature sufficiently high that it may be readily absorbed until the asbestos board is thoroughly saturated. The oil resists the water, and the graphite partly counteracts the tendency of the asbestos and oil to bake fast to the iron, thereby causing trouble when necessary to renew the joint. An extensive manufacturer in Philadelphia has been using for several years past simply linseed oil on either ordinary straw board or asbestos board. I believe they now use the asbestos in preference to the other.

For a simple dry joint requiring frequent unfastening, as igniter blocks, etc., on some engines, if asbestos board is liberally dusted with foundry facing or other very finely-ground graphite, it will entirely prevent sticking and save considerable annoyance and delay. If the surfaces of the parts contain sand holes or other indentations, where they come in contact with the packing, they should first be made perfectly smooth or even with asbestos, "Retort Cement" or some fireproof material.

It would save considerable trouble for gas-engine attendants if designers were aware of the fact (of which many are, apparently, ignorant) that with studs 10 to 12 inches in length and only six placed in a circle of 12 inches diameter it is almost impossible to make an entirely satisfactory joint. JOHN PRICE.

Philadelphia.

Trouble From Cupola.

Editor American Machinist:

Referring to article on "Trouble from Cupola," I have come across several instances in which inhabitants have complained of sparks and sulphur coming from cupola and have found that coupling the furnace top to a high chimney the best, but where this is not possible there is a stone which can be obtained from Matlock quarries, Derbyshire, which has a kind of mineral in it that when you have charged your furnace you throw a riddle full or two on top it causes the sparks to ignite into a kind of white flame and consumes most of the smoke and sulphur. This has been tried with good results in a cupola about the same capacity as the one mentioned.

PATTERNMAKER.

Leicester, England.

Settlement of the Cleveland Molders' Strike.

Editor American Machinist:

As the "American Machinist" has always shown a disposition to be fair in its statements regarding the relations of employers and employees, I take the liberty of asking you to make a slight correction in your statement under the heading "Settlement of the Cleveland Molders' Strike," appearing in your issue No. 9. In that statement appears the sentence, "Places of men leaving for any cause will be filled by members of the Iron Molders' Union, though not necessarily by ex-employees." This statement is not exactly correct and carries with it a very erroneous impression regarding the terms of settlement. I enclose you herewith a typewritten copy of the agreement, which has just been returned from our printer, and would call your attention to the second clause. In it you will find that the non-union men at present employed in the Cleveland foundries, who have been brought there by the National Founders' Association and the bonus they have been paying, must be removed from all of these foundries within forty days, and as soon as they are removed from any shop, their their places are to be filled by members of the Iron Molders' Union. The removal of all these non-union men is one of the essential points of the agreement, and I think in justice to the Iron Molders' Union that correction should appear in your paper. We have no desire to consume too much of your valuable space, but we earnestly hope that in justice to us you will place us right before your large constituency of readers.

DAVID BLACK,
Editor "Iron Molders' Journal."

"Second: The contracts now in force between the foundrymen of Cleveland and Lorain and their employees shall be completed in good faith, but no more contracts shall be made for the foundrymen of Cleveland and Lorain, unless in case of strike. The National Founders' Association shall discontinue at once advertising for or engaging molders for Cleveland and Lorain foundries, and give notice as provided in the contracts for the discontinuance of the bonus, and the National Founders' Association agree not to support any member if they refuse to comply with the terms of this agreement.

"The National Founders' Association will require not over forty (40) days for the disposition of the men now employed. As fast as the present employees leave and any shop is vacated, the Iron Molders' Union of North America agree to have that shop immediately filled with its members, and the Cleveland and Lorain foundrymen agree to accept the same to the number required by the foundrymen in the operation of their foundries and work started, the selection of the men to be left to the foundrymen. These men may not of necessity be former employees."

Chinese Methods of Measuring.

Many travelers returning from China have commented upon the apparently singular lack of knowledge of the distances across their country or between their towns that exists among the Chinese. If at one town you inquire the distance to the next you may be told that it is twenty li (one-third of a mile), but upon arriving at the town you will be surprised to find the distance back to the town from which you have just come is twenty-four li, and that the cost of journeying back again is correspondingly greater than the cost to go to it. This peculiarity also extends to distances between towns by river, the distances up stream being from 50 to 100 per cent. greater than down stream. The cost of travel and transportation in the different directions bears the same relation to each other as the distances. The confusion which has thus arisen has been incomprehensible to foreigners. The Chinese measure distances, not by rule, but by the amount of physical energy required to traverse them. Their wage is based on a unit of energy, the amount that it takes them to carry a given load, one picul one li, on level ground. If the road from A to B is down hill the distance is regarded as less than the actual linear distance, because it is supposed to take less energy to travel in that direction; or, as the Chinese say, "the li is short." It naturally follows that in traveling in the other direction, from B back to A, the road being a gradual ascent, a greater expenditure of energy is necessary. "The li are long," and in order to get a fair compensation for their work the carriers must see that the distance and the charges are correspondingly increased. With this explanation, what has often appeared as a vagary of the Chinese becomes simple and reasonable.—Leslie's Weekly.

Meeting of the Junior Mechanical Engineers.

A well-attended meeting of the New York organization of the junior members of the American Society of Mechanical Engineers was held March 6. Mr. F. O. Ball read a paper dealing with some of the details of shop management, such as the making of drawings and blueprints, a system of recording, storing and checking them, the storage and record of patterns, time and cost keeping, etc. The paper was copiously illustrated with lantern slides showing the books and forms used, and the system illustrated was carefully explained. The discussion which followed was participated in by an unusually large number of speakers, and the topic was evidently one of great interest to all present. The interest manifested would seem to carry a hint for some future meeting.

A Soldering Compound for Aluminum, and Its Uses.

The following information concerning the soldering of aluminum and the composition and preparation of a suitable soldering compound is taken from the specification of a recently issued United States patent:

Heretofore it has been generally necessary in soldering aluminum parts to first file or scrape the parts, then place a flux on the scraped surfaces, and finally apply a soldering compound with the aid of a soldering tool. The soldering of aluminum has also been effected by subjecting both the metal and solder to an extreme degree of heat and then treating the aluminum as in welding or brazing processes. Practice has demonstrated that, because of the high heat conductivity of aluminum, the heat is rapidly drawn away from the molten solder, preventing it from having sufficiently free flow. The object of this invention is to produce a soldering compound capable of ready and immediate use, the agencies necessary for effecting a thorough union of parts being constituent elements of the article as made and sold in its commercial form. The filing or scraping of the parts is avoided and the employment of a flux separate from the soldering compound is rendered unnecessary. The scraping of the aluminum surfaces is for the purpose of partially removing the surface oxids to permit the soldering compound to adhere, and it is the presence of these oxids that renders it difficult if not impossible to secure a firm joint or union between soldered parts.

The compound is composed of the following ingredients in the proportion specified: Aluminum, 20 per cent.; tin, 30 per cent.; zinc, 40 per cent., and a hydrocarbon, 2 per cent. The aluminum and tin are first melted, then the zinc is added, and after the reduction of the metals, while still in a molten state and without additional heating, there is added 2 per cent.

hydrocarbon, which is mixed with the other ingredients into a homogeneous mass. This latter ingredient may be fat, wax, paraffin, or any other species of hydrocarbon, the invention not being limited in this respect. It has been demonstrated that the addition of the hydrocarbon to the alloy by increasing the amount of carbon therein reduces and removes the oxids, which would otherwise form on the melted metal, and in consequence the carbon when cool is white and free from oxids when solid. It is the carbon alone which effects the reduction of the metallic oxids formed on the surface of the aluminum parts to be soldered, and the scraping of such parts is rendered unnecessary because of the non-presence of oxids in the soldering compound made as hereinbefore specified.

In the use of my soldering compound no mechanical device or treatment is necessary to prepare the aluminum or the solder, the soldering of aluminum parts being accomplished in the same way as in ordinary tin or other metal soldering by means of a soldering copper or bit, the solder compound being in solidified stick form. No flux separate from that contained in the commercial form of the compound is required in the application of the solder. Practice has demonstrated that aluminum parts treated with this compound have greater tensile strength at their union than at any other point and that the integrity of the joint is not impaired by time and exposure.

The patentee of the compound is Eugene M. Totten, Buffalo, N. Y.

Buying American Tools in London.

I wanted to buy something in the way of carpenters' tools, a saw, brace and bits, mitre cutter, and some planes; also a micrometer gage, some calipers and a square. To make my selection I went to a good tool dealer's, where I could get plenty of choice. At the end of my purchasing, I found myself possessed of a saw by Disstons, brace and bit by Millers Falls, mitre cutter by Lelland, micrometer gage by Brown & Sharpe, calipers and square by Starrett, and I forget the name of the maker of the planes, but think it was English. On my return from the store, I got on one of the underground tube railways and traveled in an American car drawn by an American electric locomotive.—"Mechanical Progress."

It is stated in London that the Parliamentary Committee on Water Tube Boilers is about to issue an important ad interim report declaring that the Belleville is not the best procurable design of water tube, and suggesting another as better adapted to the needs of the navy. The Belleville, however, will not meet with wholesale condemnation, and the report will enable Lord Selborne to discuss the matter in presenting the naval estimates.

For Tenement House Improvement.

The condition of the tenement-house dwellers in New York has long been recognized as not only shamefully bad, but a menace to the general health of the community. The people who live in them and who do the manual labor performed in New York are unable to secure sanitary conditions or to protect themselves from infectious and contagious diseases. Many efforts have been made to remedy this, but without material improvement. At the January meeting of Church Association for the Advancement of the Interests of Labor a petition was presented by Alexander Law, of C. A. I. L.'s organized-labor committee, discussed and endorsed, calling upon the State Legislature for such legislation as will enable the city to purchase a block of land and erect thereon a model tenement house, in which some attention will be paid to sanitary and moral surroundings. Those who may wish to sign such a petition may address Alexander Law, 223 West Thirty-seventh street, New York, and we understand that any citizen of New York State may sign it.

Personal.

A. J. McAllister has resigned his position with the Empire Engine & Motor Company, Orangeburgh, N. Y., to take charge of the toolroom of the American Machine & Foundry Company, Hanover, Pa.

Wilson P. Hunt, who has been an occasional contributor to our columns, and for seven years past has been mechanical engineer for the Deere & Mansur Company, has started a shop at Moline, Ill., which will be known as the Moline Tool Company. He will do general jobbing and repairs and build special machinery.

Obituary.

Richard Harell died at Whitestone, L. I., N. Y., March 3, sixty-two years old. Mr. Harell was for years the senior partner of Harell & Hayes, builders of steam fire engines, Paterson, N. J. He was also for a time connected with the Brooks Locomotive Works in Paterson.

Isaac La Rue, a veteran engineer, died March 6 at Plainfield, N. J., eighty-seven years old. He ran a steamer on the Vanderbilt line from New York to New Brunswick when the line was first established. He was an engineer on the Pennsylvania system for forty years, and was retired with a pension.

George H. Starbuck, Supervising Inspector of Steam Vessels at the port of New York ever since his appointment by President Arthur, died at Troy, N. Y., March 7, seventy-eight years old. Mr. Starbuck was the youngest and last-surviving brother of the three who composed the firm of Starbuck Brothers, of Troy, N. Y. The business of this firm was for many years the largest in the State outside of New York city in the line of steam engineering. They built the original Osgood dipper dredge exclusively until the expiration of the patents. Many tugs still in service on the Hudson were built by them. They were the contractors for the large iron building, Tompkins market, in this city, and all through the Civil War they turned out large quantities of shot and shell. The firm experienced some peculiar misfortunes and the business went to hopeless ruin. Many old employees have kindly memories of the last survivor of the firm.

At the plant of the Lehigh Portland Cement Company, Ormsod, Pa., March 9, an employee had his arm caught when putting on a belt, his neck came between the belt and pulley and his head was cut off.

New Catalogs.

The Pittsburg Pulley Company, 310 Lewis Block, Pittsburgh, Pa., has sent us a little priced catalog of iron pulleys—plain, split, grooved, flanged, etc. It is 3½x6¼ inches.

We have received from Hill, Clarke & Co., 156 Oliver street, Boston, Mass., a little pamphlet showing the Cross oil filters made by the Burt Manufacturing Company, Akron, O. It is of standard size, 3½x6 inches.

The Sebastian Lathe Company, Cincinnati, O., has published a new illustrated catalog and price list of the engine and speed lathes, etc., which it manufactures. Engine lathes of 13, 14 and 15 inches swing, power speed lathes of the same and foot-power screw-cutting lathes are among the machines shown. The company is a dealer as well as manufacturer, and has included in the catalog a varied line of machinists' tools, small and large, including planers, shapers and drill presses. It is 6x9¼ inches.

The Diamond Machine Company, Providence, R. I., has gotten out a new edition of its catalog of grinding and polishing machinery, lever and screw-feed lathes, special machines, polishers' supplies, etc. The line of grinding machinery is an extensive one and includes numerous special machines for grinding different sorts of tools, punches and dies, ball cases, etc. The line of surface grinders and the belt-strapping attachment may be noted among other features of the pamphlet. It is 6x9 inches, standard size.

Manufacturers.

The Port Clinton (O.) Canning Company will erect a plant.

A plant will be erected for the Imperial Coating Mills, Kalamazoo, Mich.

The Stoever Manufacturing Company, of Myerstown, Pa., will erect a large machine shop.

The Mahoning Rubber Company (capital, $400,000) will locate a new plant in Youngstown, O.

A large continuous heating mill is to be built for the Tennessee Coal, Iron & Railroad Company.

It is reported that H. W. Mann will put in a palmetto fiber factory at Waldo Farm, near Deland, Fla.

The American Magnesia Company will have another mill building erected at its plant in Plymouth, Pa.

The factory of R. Alden & Sons, manufacturers of organ stops, Waukegan, Ill., was recently burned.

The McCormick Harvesting Machine Company, Chicago, will enlarge its storage and repair plant at Indianapolis, Ind.

The Virginia-Carolina Chemical Works at Savannah, Ga., were burned March 2. Loss, $115,000, covered by insurance.

Mayer Bros.' machine shop and foundry, Mankato, Minn., were burned recently. The loss is about $7,000, fully insured.

Indications are that the Kokomo Steel

(*Continued on next page.*)

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant ; see p. 24.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Forming lathes. Mer.Mach.T.Co.,Meriden,Ct.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

For Sale—4 H.-P. boiler, cheap. L. Box 156, Mt. Carmel, Ill.

Gasoline motor castings ; best jump-spark plug made. Orswell, 34 Beach, Boston.

Wanted—Improvements in grinding machinery. Address Box 1435, Providence, R. I.

Light and fine mach'y to order ; models and elec. work specialty. E. O. Chase, Newark, N. J.

Book "Dies and Diemaking," $1, post paid. J.L.Lucas,Bridgeport,Ct. Send for index sheet.

For circular of new book on steam engineering, address W. H. Wakeman, New Haven, Ct.

"Brandt's Triple Expansion Gaskets" are the best for boilers. Randolph Brandt, 38 Cortlandt st., New York.

For positions in charge, or competent men for such positions, address James Brady, 220 Broadway, New York City.

Designing, manufacturing machinery, automobile engines and experimental work for inventors. Oul Machinery Co., Newark, N. J.

Patternmaker, A1, well-equipped shop at home, will do light or medium pattern work of the better class at reasonable rates. Box 362, AMERICAN MACHINIST.

Made to Order—Special clock movements, metal novelties : gears a specialty ; difficult work our specialty. Smith Novelty Co., 28 Commerce st., Trenton, N. J.

Ice machine business for sale ; patterns, drawings, patents, tools, well-known machine ; price reasonable ; good side line for machine shop. Box 347, AMERICAN MACHINIST.

Wanted—A good business man with $8,000, to take interest in gas-engine works ; business already established ; give full particulars. Flickinger Iron Works, Cochranton, Pa.

Wanted to Manufacture—An established manufacturing concern desires to secure a patented specialty to manufacture in steel castings. Address "Specialty," care A. MACH.

Important.—Manufacturer desiring a thoroughly competent and reliable representative in New York city, in the best business location, at moderate expense, will please address Box 381, AMERICAN MACHINIST.

Institutions retiring from business having machine tools, brass and wood working machinery will find it to their interest to correspond with us. We purchase complete plants or handle them on com. C. C. Wormer Mach. Co., 55-59 Woodbridge st., W., Detroit, Mich.

For Sale or to Let—Factory, brick, engine, boiler, shafting, drafting room, high ceilings, fine light ; immediate occupancy ; rail and water ; near New York ; wages moderate ; strikes unknown ; suitable any business. "Rare Opportunity," AMERICAN MACHINIST.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded ; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents.

Situations Wanted.

Draftsman wants position. Box 372, AM. M.

Toolmaker, machinist, seeks position. Box 371, AMERICAN MACHINIST.

Toolmaker seeks position as foreman. Box 373, AMERICAN MACHINIST.

Mechanical draftsman wishes steady position. Box 378, AMERICAN MACHINIST.

Draftsman—Temporary or steady work, drawing or tracing. C. K., Box 368, AM. M.

Patternmaker, temperate and steady, age 27, understands wood and metal patterns, desires foremanship. Box 366, AMER. MACH.

First-class toolmaker wishes position as draftsman ; can give reference as to character and ability. Box 365, AMER. MACHINIST.

Wanted—Position as foreman boilermaker, stationary, marine or locomotive boilers, tanks and plate ironwork. Henry Mellon, 364 E st., South Boston, Mass.

Wanted—By foundry foreman, foremanship of foundry making engine castings or general jobbing, heavy or light. Address Box 178, AMERICAN MACHINIST.

Experienced man wants to represent handling general machinery and supplies, to establish New York office or travel and installation. Box 363, AMERICAN MACHINIST.

Shop systematizer, gas engine designer and owner of valuable patents on crude-oil attachments for gas engines, wants position. Address "Petroleum," care AMER. MACH.

Draftsman, experienced on general power and special machinery, shop tools, laying out of plants, shops and mills, erecting and maintenance of same. Box 354, AMER. MACH.

Bookkeeper and accountant, age 27, who thoroughly understands his business ; competent to take full charge office, shop and outside work. Box 369, AMER. MACHINIST.

Wanted—By a hustling young man, position as general foreman or superintendent of plant building paper-mill machinery ; am a systematic cost-reducer. Box 377, AM. M.

Foreman machinist, technical education, thoroughly up to date, can handle men successfully, wishes to change position ; best of references. Box 375, AMERICAN MACHINIST.

Situation wanted by an experienced superintendent of machine shop and foundry ; experienced on engines and general mill work of all kinds ; age 37. Address D. W. G., care AMERICAN MACHINIST.

Wanted—By a man, 30, technical education, 4 years on machine design, etc., 2 years on design similar to cash-register work, position as designer or assistant to engineer. Box 353, AMERICAN MACHINIST.

An office manager, thoroughly familiar with gas-engine business, would like to represent responsible manufacturers of gas engines, or other power-plant equipments, in Pittsburgh or vicinity. Address Box 340, AMER. MACH.

Machinist, 20 years' practical experience, 9 years as foreman, would like position as foreman in machine shop, to take charge of erecting or general repairs ; A1 references furnished. Address "Elevator," care AM. MACH.

Graduate in mechanical and electrical engineering, with experience in steam engineering, electric traveling cranes, rolling-mill machinery, special machinery and jigs, seeks extra evening work. 546 S. 52d st., Philadelphia, Pa.

Young man, energetic, capable and reliable, desires position in any capacity requiring above qualifications ; technical graduate ; experienced draftsman ; nearly 4 years on steam power plants and elevator and conveyor machinery. Box 364, AMERICAN MACHINIST.

A position as superintendent of a machine, foundry and pattern shop ; engines, air compressors or machine tools preferred ; by a man with technical education and 14 years' practical experience ; best of references furnished. Box 367, AMERICAN MACHINIST.

Position as superintendent, by experienced mechanic ; can produce good work, not excuses ; can successfully figure on work or contracts ; machine tool or light automatic machinery my specialty ; East preferred. For references address Box 376, AMER. MACH.

Superintendent ; am thoroughly acquainted with manufacture of machinery, instruments, tool and pattern-making, woodworking and brassfoundry ; capable handling large number hands ; good organizer, constructor ; energetic and ambitious. "Industrious," care AM. M.

Mechanical engineer, extensive shop and business experience, technical education, member A. S. M. E., seeks responsible position ; specialties, high-grade engines of all types and large high-duty drainage and irrigation machinery ; controls valuable patents. Box 374, AMERICAN MACHINIST.

Manager of executive ability and practical experience as a mechanic desires a change of position ; expert in modern methods of production in machine shops, foundries, etc., in various lines of product ; thoroughly familiar with all systems and practice necessary to insure economical production. "Manager," care AMERICAN MACHINIST.

Help Wanted.

Wanted—Draftsman, experienced on air compressors ; steady work. Box 343, AM. M.

Wanted—A few first-class toolmakers for light work on dies and jigs. Address the Blickensderfer Mfg. Co., Stamford, Conn.

Wanted—Several good mechanical draftsmen ; graduates of technical school preferred. Address Shickle, Harrison & Howard I. Co., E. St. Louis, Ill.

Wanted—Superintendent for automobile factory who is capable and energetic and able to invest moderately in company. Address "Steam," care AMERICAN MACHINIST.

Wanted—Man capable of taking charge, who is thoroughly acquainted with up-to-date practice in milling, large and small ; must be able to tabulate results in a neat and concise manner. Address E. M. C., care AM. M.

We are enlarging our works, and will shortly require an increased number of skilled mechanics ; we invite application from pattern makers, molders and machinists. Address the Westinghouse Machine Company, East Pittsburgh, Pa.

Wanted—By a concern manufacturing high-speed engines, a mechanical draftsman and designer with experience on tools and fixtures ; permanent position ; location, vicinity Trenton, N. J. ; state experience, age and salary required. Address Box 333, A. MACH.

Wanted—Superintendent for manufacturing concern, including windmill and blacksmith shops, employing about 150 men ; must be energetic and familiar with up-to-date shop practice ; state age, experience, references and salary expected. Address Box 380, A. MACH.

(*Continued on next page.*)

PLANISHED STEEL BARS.
ACCURATE, STRAIGHT, POLISHED,
ROUND, SQUARE, FLAT, HEXAGON,
For Shafting, Machine Rods, Keys, Guides, Screw Rods &c.
THE C. PARDEE WKS. PERTH AMBOY, N.J.

ASK THE MAN
WHO HAS USED A
Universal Machine Company Grinder
To tell you all about it. His reply will be it is
ALL RIGHT. He knows. Write for list of users.
Universal Machine Company, 78 Cromwell St., Providence, R.I.

(*Continued from preceding page.*)

Wire & Nail Company, Kokomo, Ind., will add a rod mill to its plant in the spring.

Estimates are being made on a new factory building for the Benton-Armstrong Folding Paper Box Company, New Haven, Conn.

The Lexington (Miss.) Cotton Mills (J. E. Stanfield, secretary and treasurer) are inviting bids on the erection of buildings.

J. Mikesell & Co., of Charlotte, Mich., will erect a canning factory at Shelby, Mich. There will be a 30x30-foot engine house.

The Sefton Manufacturing Company, manufacturer of butter dishes, will put up an 80x100-foot building at its plant in Anderson, Ind.

The Porter Screen Manufacturing Company, Winooski, Vt., maker of doors, etc., will rebuild its factory, destroyed by fire, on a large scale.

The McCullough Iron Company, manufacturer of galvanized sheets, etc., Wilmington, Del., will have an addition made to its factory.

A large manufacturing plant is to be built in New Jersey for the Circular Loom Company, with present headquarters in Chelsea, Mass.

A factory is to be built in Media, Pa., for the International Separator Company, of Philadelphia, manufacturer of creamery supplies.

It is understood that the power-house of the Chester (Pa.) Traction Company will be enlarged and boilers and special machinery put in.

Plans have been completed by the Lima (O.) Iron Fence Company for an addition to its plant, which will be erected in the near future.

The Jackson (Miss.) Fertilizer & Acid Phosphate Company, recently incorporated with a capital stock of $100,000, will build a factory.

The National Lead Company has begun work on a mill and furnace building, 70x103 feet, at 260 to 278 West Eighteenth street, Chicago.

An electric plant is to be installed to light the county jail and Court House at Peoria, Ill. Parr & Hulsebus have been working on the plans.

Adams & Dyas, of the North Alabama Engineering Company, will erect at New Decatur, Ala., a brick factory, with a capacity of 50,000 bricks a day.

The American Product Company, Philadelphia, Pa., is building a 65x75-foot boiler-house addition to its plant at Morris street wharf, Schuylkill River.

Another cotton mill will be erected at Sylacauga, Ala., by Dr. J. E. Pearson, president of the McDonald Cotton Mills Company, of that place, and associates.

The Chapman Double Ball Shafting Bearing Company has been chartered in Maine; capital, $500,000. The president is Samuel H. Folsom, of Winchester, Mass.

The Terre Haute (Ind.) Glass Manufacturing Company, known as the Streeter Glass Company, will remove from Philadelphia a factory to make caps for fruit jars.

Brening Brothers, Springfield, O., who will build a plant for the manufacture of steam and gasoline engines for automobiles, are in the market for a few machine tools.

The Koenig & Luhrs Wagon Company, Quincy, Ill., will erect a three-story 65x100-foot addition to its factory. It is to be equipped with the latest machinery.

Plans have been finished by Architect Joseph M. Huston, Philadelphia, Pa., for a factory,

(*Continued on next page.*)

Help Wanted—Continued.

Wanted—An all-round machinist as working foreman of a shop in Minnesota employing from 3 to 6 machinists, doing general repair and new work; must be sober and reliable; one that has experience in such shop preferred. Address Box 379, AMER. MACH.

Wanted—Several experienced mechanical and electrical draftsmen, also some first-class mechanical designing draftsmen; the latter need not be electricians. Apply, giving age, record, references and salary required, to Engineer, Drafting Dept., General Electric Co., Schenectady, N. Y.

Superintendent wanted; first-class man who has had thorough and practical experience in the manufacture of taps, dies and screw-cutting tools, who can work the cost down to the lowest price; an expert in steel and experienced in handling men. Address F. C. Furnesdy, Springfield, Mass.

Wanted—Machine foreman who is a thorough mechanic and experienced in handling men and work to best advantage; one who is accustomed to piece system preferred; applications will be kept confidential. Address, stating age, experience and reference, H. D. C., care AMERICAN MACHINIST.

Wanted—A first-class machine shop foreman for light automatic work, in New York city; must have good experience, up-to-date methods and understand drawings; good, steady position for right man. Address letters, stating experience, age and salary wanted, Box 358, AMERICAN MACHINIST.

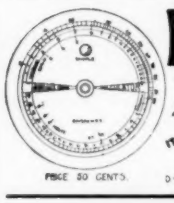
Wanted—A man between the ages of 25 and 35, to supervise the inspection of raw and finished parts; must have good education; college or technical school training preferred; also some practical mechanical experience; salary, $800 to $1,200 per year. Apply or address Employment Bureau, National Cash Register Company, Dayton, Ohio.

Wanted—A foreman for the screw-machine department of a large manufacturing establishment; only those who have had experience in the operation of hand screw machines need apply, and preference will be given to those who have had the additional experience of operating automatic screw machines; applicant must have had charge of men and know how to arrange machines to produce work rapidly and accurately; in writing, advise fully past experience, give references, present employment and salary expected. Address Box 370, AMERICAN MACHINIST.

Draftsmen Wanted.

WE have positions open for capable, experienced Mechanical Draftsmen Our business is to assist Draftsmen and Engineers (technical men only) to secure positions when unemployed, and to better their positions when employed. Our business was established in 1893.

Address THE ENGINEERING AGENCY,
1605 Monadnock Block. CHICAGO.



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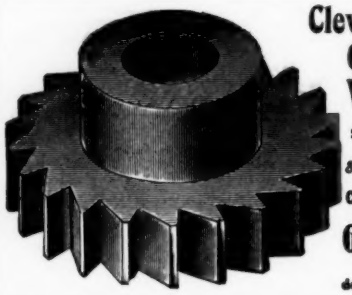
PRICE 50 CENTS. D. WALLACE, 260 CARROLL ST. BROOKLYN, N.Y.



Cleveland Gear Works
W. R. SAWYER, Lessee.
86 Seneca St., Cleveland, Ohio.
GEARS of all descriptions

EUROPEAN AGENCY.

An old established English firm of merchants is open to consider a few additional agencies for American Machinery and Appliances in Europe. They have several houses in the United Kingdom, including central premises in London, and large Warehouse accommodations at Liverpool Docks. One of the principals expects to visit the U. S. A. shortly. Address

Box 361, American Machinist.

Wanted. *To purchase, or manufacture on a royalty, patented machine tools of new design or now on the market, for which there is a legitimate demand at a fair profit.*
Address Lock Box 21, Station B, Cleveland, O.

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Mechanical Movements, Powers, Devices and Appliances,
By Gardner D. Hiscox. **Price, $3.00**
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By Gardner D. Hiscox. **Price, $3.00**
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By Parsell & Weed. **Price, $2.50**
Liquid Air and the Liquefaction of Gases,
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Gas, Gasoline and Oil Engines,
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By Prof. T O'Conor Sloane. **Price, $5.00**

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This Is The Boss Bench Trimmer

of the whole bunch. It covers a larger range of angles than any other bench trimmer in the business—just twice as many as any other, except our little No. 0. There should be a No. 6 Oliver Trimmer for each workman in your pattern shop, to do work that no other trimmer can do. It has a solid knife—no

screws to be taken out in removing the blade for sharpening. Gear and rack are up out of the way of dirt and chips. No. 6 cuts 8½ inches in length, 5 inches in height, and trims the cost of pattern-making right down to the last cent. You'd better ask us for all the details on this and our other fourteen sizes.

American Machinery Co.
Grand Rapids, Mich.